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McGRAW-HILL PUBLISHING COMPANY, INC.

August 21, 1926

Uses for Copper Slag in Construction Work

By E. E. Thum

Underlying Principles of the Limestone Replacement Deposits of the Mexican Province - II

By Basil Prescott

Lead-Zinc Chimneys in Limestone

By J. E. Spurr

Driving Timbered Raises at Butte

By Clarence M. Harrer

Biography of John A. Burgess

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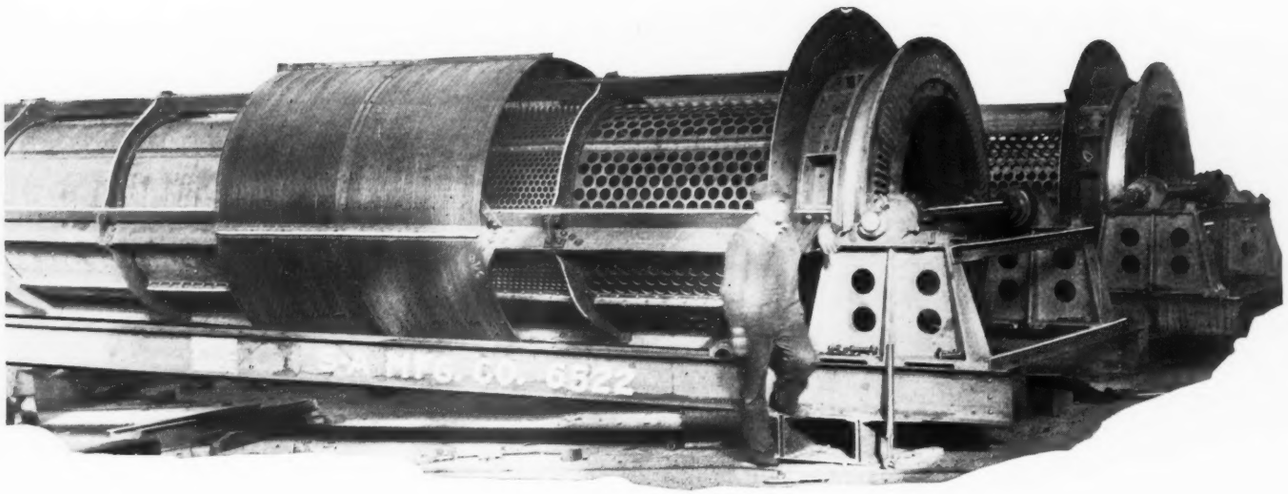

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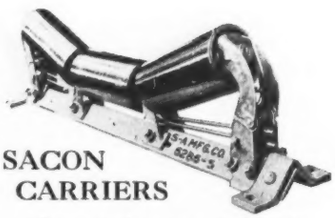

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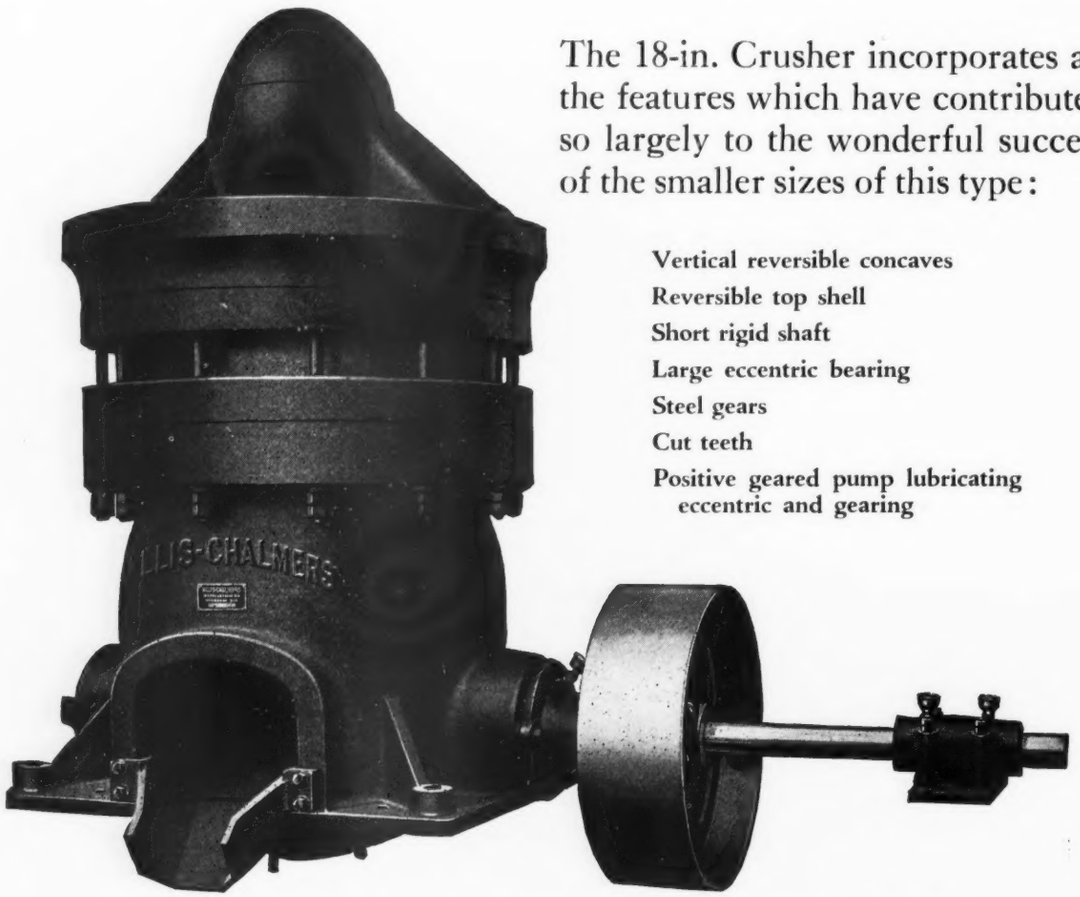

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ENGINEERING AND
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JOSIAH EDWARD SPURR, Editor

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The Passing of Mining Centers

THE EXHAUSTION OF MINES and mining districts, the consequent migration of centers of mining activity and of metal production and fabrication, and the social and industrial changes entailed, are striking and familiar enough in the case of those speedily bottomed desposits of the higher grade and rarer metals. Deserted or obsolescent mining camps are familiar throughout the West; the glories of the Comstock and of Eureka, of the placer gold of California and even of Alaska, are definitely recognized to have passed. Of the more common metals, which occur as huge deposits, this law is slower of operation; and even if it moves swiftly enough to the vision of the student, the man on the street, whose daily newspaper is his chief source of current education, is slow to recognize or to acknowledge it. Such is the situation in petroleum, even more so in iron, and still more so in coal. Therefore it is remarkable that the chief theme of discussion at the Iron Ore Session of the Associated Technical Societies of Cleveland, recently, should have been the acknowledged fact of the imminently approaching progressive exhaustion of the Lake Superior high-grade ores and the problems of substitution, especially of lower-grade ores made amenable by beneficiation.

On the various papers presented, Dr. W. O. Hotchkiss commented,[1] and drew the conclusion that at the present rate of production the known reserves of merchantable grades of iron ore will be exhausted in twenty years; but as the consumption of iron ores will increase, the estimate must be accordingly shortened. He points out that this is not an outlook which concerns only the mining industry, but the industries which make iron and steel products; a total of 8,000,000 people in the northern Mississippi Valley are dependent on the static production of Lake Superior iron ore. Should the production of this ore fall off, the ores which are nearer the Atlantic seaboard, in the New York-New Jersey region and in the southern states, and the ores of Cuba, South America, and Europe, stand ready to take their place. If the low-grade Lake Superior ores can be treated at sufficiently low cost, much of this shifting of mining and industrial centers can be obviated or at least long delayed, for the Lake Superior region has a great reserve of ores of a grade not now merchantable in the competitive market.

The paper by Mr. W. G. Swart, manager of the Mesabi Iron Co., whose plant at Babbitt is closed because the ore there beneficiated cannot compete in price with high-grade ores, included a number of diagrams, published without comment. These diagrams show the curve of production at Cripple Creek to have been much like that in Broken Hill, in Australia. The maximum production in Cripple Creek was in ten years from the discovery; from then the gradually decreasing, but still great production, lasted for fifteen years, when the final swift decrease set in, from 1915 to the present date. At Broken Hill the maximum was in eleven years after discovery; the sustained production barely for five years thereafter; and then the long decline from 1914 to the present. Another chart shows that eleven now exhausted iron mines in the Mesabi range rose to their maximum production in some five years; thereafter the continual decline took twenty years. From this it will be seen that the relatively long life which the Lake Superior iron ores have already shown is not because of lack of human ability to mine and exhaust, but to a limited market, which did not exist in the case of the gold ores of Cripple Creek or the lead-zinc ores of Broken Hill.

[1]Reported by *Mining and Metallurgy*, August, 1926.

No Time to Cut Copper Prices or Increase Production

SINCE THE MIDDLE OF JULY copper prices have been above 14c., net refinery, for the first time this year with the exception of a brief period in February, when there was a mild scramble to get the metal owing to the news of the probable formation of a new export association. The recent strength has had a more solid foundation; it may be attributed to excellent domestic buying throughout the month of July, accompanied by a slight decrease in the output of North American smelters. It can hardly be expected that sales during August will come up to the extremely large total of July, but it will be unfortunate if the large producers let this fact worry them and cut prices down below the 14c. level again in an endeavor to stimulate sales in an unwilling market.

Some of the smaller agencies make it a practice to sell fairly regularly at the best price that can be obtained, and so long as the big fellows are as well sold out of current production as they are at present, it would seem good policy for them to refrain from competing with those who must have some business and who are willing to make price concessions to get it. Unless industrial conditions in the United States become worse this fall (and there is no indication now that they will) all of the present production of copper will be required; and by firmly maintaining present prices, producers should be able to sell their current output without difficulty as soon as the buyers are again ready to come into the market.

Neither should producers be tempted to mine more copper, now that the price is above 14c. Stocks of blister and refined amounted to 337,045 tons at the end of July, which is almost exactly the average stock during the preceding six months, in none of which was there much variation. This seems sufficient and is somewhat above the average stock carried in the last quarter of 1925, which was about 318,000 tons. There is certainly nothing in any recent statistics to indicate any shortage of copper. Production in the last year or so does not seem to have been greatly influenced by

changes in price; in the last eight months, with the average monthly price of copper uniformly below 14c. refinery, United States primary smelter production averaged 79,844 tons per month, whereas in the seven months of 1925 that the price was above 14c., smelter production was but little more—80,847 tons per month. It seems, therefore, that the 14c. level has not been a critical one so far as production goes, and it is to be expected and hoped that no marked increase in output will be decided upon with copper between 14 and 15c.

Welding and the Welder

IT IS GENERALLY RECOGNIZED that welding equipment, either gas or electric, is something that the modern mine shop cannot afford to be without. Its use has become standard practice. Especially for quick repairs in remotely situated plants has it proved its value. Here the lack of it may mean a shutdown of considerable length, if a vital machine part breaks. Lost time eats into profits, if there are any; if there be none, it swells the loss. The cost of a single shutdown may exceed the cost of a welding outfit. Thus the value of welding to the operator is evident.

But the art of welding properly must be understood by the man whose job it is to repair the broken part. The shop man must know a little more today than he did ten years ago. It is up to the master mechanic to see that he has some one on his force who can do a good welding job when wanted. The manufacturer will co-operate with him in training such a man, if necessary. The advantages of welding, in an emergency, are too great to lose by negligence in this matter.

Agitation Against California Blue-Sky Law

AN INSIGHT to mining trends is afforded by a recent press note put forth by the State Corporation Department of California. According to this the mining division of the department issued permits for the sale of stock in California to twenty-seven mining companies during May and June. The aggregate capitalization of these companies is $14,587,000 and ranges from $50,000 in some of the smaller companies to $4,000,000 in one of the larger ones.

Several conclusions can be drawn from these figures. California must be a good state for the marketing of mining stock. Money must be plentiful and buyers not particularly exacting. It would appear also that the State Corporation Department is tolerant and does not apply especially stringent requirements. It is a fair question to ask how much of this $14,587,000 is going to be distributed for machinery, buildings, supplies, and labor, and in actual exploration. How much is to be expended in payments for property? How much of it is to be paid to promoters?

These questions cannot be answered except in a general way. Practice of the Corporation Department allows 50 per cent of the stock as promotion stock and escrows this stock. This automatically reduces the $14,587,000 to $7,293,500 as the amount to be sold to the "public." An allowance of 20 per cent additional is made for stock sale expense. This amounts to $1,458,700, leaving a balance of $5,834,800, which presumably goes to the mine. According to available information it is the practice of the Corporation Department to allow stock to be sold where the company has only a bond upon the property, but where the amount of the purchase price payments appear to be excessive such payments are considered as part of the promotion. Payments on the property can be made from receipts of stock sales only where there is a material showing of ore and where the company is sufficiently financed to carry out its development plans as well as to make the required payments. It is necessary to distribute such payments so as to give the company sufficient time in which to develop the property and make it possible to meet the property payments out of the production proceeds. In no case is a company permitted to use the proceeds of stock sales to purchase unproven property where such sales would be for the sole benefit of the promoter or vender.

From the foregoing it would appear that a considerable part of the $5,834,800 will be spent for exploration, development, equipment, and production. The promoter, on the other hand, does not get away scott free with $7,293,500, but has to spend money out of his private resources to meet property payments and other expenses. Thus, if the promotion stock is finally sold at the price of issue of the first 50 per cent of the total stock, the promoter receives $7,293,500, less his expenses. However, he must wait for this until the property is on its legs or can show that it has paid dividends from undivided profits of 10 per cent per annum and is in a good financial condition or when the company can show that its assets are equal to or greater than the par value of the stock outstanding. Holders of promotion stock usually participate in dividends. In the event of failure the right to participate is waived by the holders of promotion stock.

An unprejudiced person will agree that there is a considerable amount of fairness in the rules of the game as laid down by the corporation department, but he cannot avoid the conclusion that the promoter has the largest share in the profits if such there be.

Opposition of a certain kind has developed against the California blue-sky law and its administration. A "Mineral Industry League" has been formed in Los Angeles, and efforts are being made to secure members in northern California. The sponsors of the "League" are stated to be C. M. Fickert, an attorney; Sidney Norman, editor of the Southwest Mining News Service, and R. D. Harris, publisher of the *Spring Street Journal*, of Los Angeles. According to the *Nevada Mining Press* anent the "League":

> "Candidates for Governor and for the Legislature who are in favor of the repeal or drastic amendment of the act (blue-sky law) will be supported for office, and those who are for the law will be opposed. The League advocates a measure similar to the Colorado law, which leaves the promoter unhampered, but requires publicity and holds him accountable for fraud. It favors a plan for the submission of oil and mining promotions to the state mining bureau, for examination of properties. Nevada is vitally concerned in the matter. Of late years it has been found impossible to finance a Nevada mine in California, no matter how worthy it might be. This state (Nevada) should give its hearty support to the Mineral Industry League."

The *Nevada Mining Press* has only to study the history of the "Divide boom" to find a good reason for the slow-footedness of the California speculator. The memory of that fiasco is deeply dented. The Mineral Industry League does not appear to have any great support except from the stock-selling fraternity. A certain type of promoter is harassed by any restriction at all. The blue-sky law must be moderately effective, otherwise no one would be especially interested in its

repeal or drastic amendment. It is, as we view it, a reasonable protection of the good repute of the mining industry. Those who have preyed upon the public through the medium of the mining and petroleum industries have only themselves to blame for the presence of these laws. Undoubtedly more or less hardship to honest promoters and mining men is involved in the administration of blue-sky laws, but this cannot be avoided as long as there are unscrupulous promoters and dishonest mining men. The contention that blue-sky laws are killing the "mining game" is refuted by the number of permits asked for and granted in two months in a state that the "gamesters" hold up as an opprobrious example of restriction.

Wanted: A Book on Flotation

THE FLOTATION PROCESS has advanced so rapidly in the last three or four years that books on the subject, of which four or five were published between 1915 and 1921, have become almost entirely obsolete so far as their usefulness extends to the up-to-date selective flotation operator. Requests come in very frequentlty nowadays for references on this subject, but it has to be admitted that the available books give little or no information about the use of such reagents as xanthate, thio-carbanalide, xylidine, copper sulphate, zinc sulphate, and sodium cyanide, now so generally used where two valuable minerals must be separated from each other, or where it is desired to separate one valuable floatable mineral from another that is floatable but not valuable enough to save, such as pyrite. The flow sheets given in the available books have been generally superseded, and the metallurgical data given afford, of course, a poor picture of what is being done nowadays.

The theoretical basis of flotation was the subject of much speculation a few years ago, and occupies considerable space in the books that were published at that time; much of this comment is still relevant, for no generally accepted simple theory of the flotation process is yet at hand. Many physical principles are known to play a part, but the time has not yet come when one can take a complete chemical and physical analysis of an ore to his desk and work out, with pencil and paper and brains, just what reagents to use and how to apply them. Rather is it necessary to make many laboratory and mill tests, for the modern commercial mill flow sheet is still a pretty empirical matter. Experience on similar ores is the best guide to what to do and expect.

The available books also contain an abundance of material regarding patent litigation, but this unpleasant side of the flotation process is given little attention nowadays, even, apparently, by the lawyers themselves, for it seems that certain accountings, decisions, and threatened injunctions have been dragging along for years. Most operators have taken out Minerals Separation licenses, and that organization has adopted a much more reasonable attitude regarding the release of information and in other matters than in days gone by.

To be sure, this journal, and others to a less extent, have published many articles describing modern flotation practice and commenting upon it, and various state and government bureaus have issued several valuable bulletins, but this published material cannot be collected together conveniently by the casual inquirer. The young engineer just breaking into the game, and the engineer in foreign and inaccessible parts of the world would welcome an up-to-date work by an authority able to summarize existing theories and describe, and intelligently comment upon, current practice.

Internationalism by Capital

A NOTED EUROPEAN ECONOMIST, speaking to the Institute of Politics at Williamstown the other day, described the recently arranged Franco-German steel and coal trust, which has been ratified by a "commercial treaty" between the two countries, as a form of international co-operation and influence destined to supersede the old-fashioned political treaty, which built up frontiers and erected tariffs on the plan of difference in race, language, or geographic boundaries. This is the same thought that was voiced in this column a few weeks ago, taking as a text some of these international combinations for control of minerals and metals which are now much in evidence, although not greatly advertised. The tendency is exhibited in other commodities, but is especially marked in the case of minerals; and has been focused on these because of the fixed and unalterable laws which control their occurrence and production. In copper and quicksilver, iron and steel, lead and zinc, aluminum and vanadium, nickel and petroleum, we see evidence of the swift-moving hand and brain of business geniuses moving ahead of and independent of their respective political governments, which are to a large extent even unaware of what is going on; and, to a large extent, vaguely hostile to the idea as apprehended, continue to tinker at tariffs. The speaker at Williamstown pointed out that the movement toward internationalism by labor had been far outstripped by this recent movement of capital toward internationalism, and he prophesied that the chief objection would come from labor itself, which would not be satisfied with the leveling process which it had so long theoretically advocated.

International Mine Rescue and First Aid Meet

SAN FRANCISCO has been designated as the place for the next International Mine Rescue and First Aid Meet on Aug. 30 and continuing to Sept. 4, 1926. The U. S. Bureau of Mines and the American Red Cross conduct the contests, which are also to be sponsored by the California Metal and Mineral Producers' Association and the California Society of Safety Engineers. Entries have been filed by 51 teams from 14 states and by 34 local teams for the state contests. Coal, metal and non-metallic mining companies are interested in furthering these general meets, which have for their purpose the wide dissemination of safety practices and the stimulation of interest in the fundamental idea of safety in industrial operations.

Since the inception of the safety movement there has been a gradual growth in appreciation of the humanitarian and economic principles involved. There is a keener interest now in the details of preventive practice. The two-day safety conference which is to be included in the program of the meet should have a special value in that advanced ideas can be given publicity and practices in different industries made known. Mining men of California should support the coming meeting. The cement industry of that state as well as the petroleum industry has generously contributed to the expenses of the gathering. Mining men and mining organizations should show an equal interest.

Mining Engineers of Note

John Albert Burgess

JOHN A. BURGESS, mining engineer and geologist, began his career as a surveyor in the employ of the Tonopah Mining Co. at Tonopah, Nev., after graduating from the University of California in 1906. Not only did he discharge his everyday tasks well, but he also manifested a keen interest in geological conditions in the important new mining district. He obtained a petrographical microscope and began a thorough study of structural and mining conditions in the company's property. This, apart from its value to the company, resulted in the publication of an instructive article about the producing mines, which appeared in *Economic Geology*. He was advanced to the position of geologist for the company and eventually to the position of chief engineer. A number of mine examinations were made in the interest of the Tonopah Mining Co., which sought to extend its mining business in other mining districts. This company was one of the most successful in the Tonopah district and is still producing, although at a much smaller rate than in the flush period of its existence.

A silver-gold ore deposit at Wonder, Nev., was selected by the Tonopah Mining Co. for development and operation. Burgess was placed in charge of the company, which although backed by leading men of the Tonopah Mining Co., was a separate organization and was called the Nevada Wonder Mining Co. The property proved remunerative under the excellent management of Burgess, who directed its destinies for five years. He gained valuable experience in handling men and affairs and made a praiseworthy record at this property, which attracted general attention.

Burgess was selected by Seeley W. Mudd, with whom was associated Philip Wiseman and Frank Keith, to manage the United Eastern property, at Oatman, Ariz. This appointment resulted from the consistent growth shown by the young mining engineer and the general knowledge of his successful handling of mining properties.

A mining and metallurgical plant was constructed under Burgess' supervision, and the mine was started on its notable career. It proved to be a consistent producer, well justifying its purchase by Colonel Mudd and his associates. In all, over $14,000,000 in gold was produced, and because of the high operating efficiency and well-engineered installations a considerable proportion of the production was turned into dividends. The mine was worked to exhaustion, although Burgess did not stay to the final wind-up but left in 1920 to enter upon his work as a consulting engineer and geologist, in which he has built up a substantial clientele. His practice has taken him into many states and at times into the foreign field.

Mr. Burgess married Miss Florence H. Du Bois in 1907 and has two sons and a daughter. He lives in Berkeley and makes his headquarters in San Francisco. His publications have been principally on economic geology. He is a member of the Institute of Mining and Metallurgical Engineers as well as the Mining and Metallurgical Society of America.

Uses for Copper Slag in Construction Work

Some Kinds Form Satisfactory Concrete Aggregate—Also Utilized for Foundations

By E. E. Thum
Union Carbide and Carbon Corporation
Formerly Chief Engineer, Great Falls Reduction Department,
Anaconda Copper Mining Co.

A RECENT EDITORIAL in the *Engineering and Mining Journal-Press* resurrects the old question of utilization of slag from copper furnaces. Iron furnaces make use of their slag; why not copper furnaces? Anyone knowing much about metallurgy appreciates of course a fundamental difference in the problem. In the first place, not all iron blast-furnace slag is utilized, by any means. A favorable combination of economic conditions is necessary before it can become a component of cement. These conditions seldom or never exist in the copper-smelting centers. Second, the chemical composition of the copper-furnace slag is entirely different from the iron-furnace slag, copper slags being essentially iron-lime silicates with more or less aluminum and frequently some zinc.

About fifteen years ago experiments were made at the Great Falls Reduction Department of the Anaconda Copper Mining Co. in the manufacture of cement from copper blast-furnace slags. Some very good cements were made on a laboratory scale. By "very good" is meant cements which withstood admirably alkaline corrosion, a factor of great importance in that region, where the life of ordinary cement structures exposed to ground water is relatively short. Unfortunately, however, these cements all were very quick-setting, some of them hardening instantly on being moistened. No method was found of slowing down this chemical reaction, and the experiments were abandoned. However, this quick-setting cement came in extremely handy in stopping some very annoying and persistent leaks in concrete cellars made of the usual materials. In passing, it may be remarked that another byproduct of this investigation was the indication that almost any cement—even commercial cements—could be made to resist alkaline corrosion excellently by burning at a very high temperature. In other words, the resistance to alkaline corrosion seemed to depend more upon the temperature of burning than upon any other factor.

Casting fluid slag into molds to make brick or slabs has been frequently proposed and tried. The drawback to this is that the completed product is most often very fragile and brittle, and cannot withstand the rough handling any construction material receives. "Annealing" has been proposed, but whether the results are encouraging, either from a physical or monetary point of view, I do not know.

Some granulated slag has been used for the manufacture of "sand-lime" brick. Here again commercial considerations rule. Sand-lime brick, though having excellent physical properties and appearance, will generally have difficulty in competing on a price basis with pressed brick for facing purposes. Clays suitable for common brick are widely distributed; few situations exist where they cannot be imported and sold below the cost of locally made sand-lime brick.

Granulated slag has also been suggested for railroad ballast. A considerable quantity of this was used on the Butte, Anaconda & Pacific Railroad soon after its construction, but the material did not find favor, because the granulated slag has no cementing power. The sandy material under the ties remained sandy and shifting as long as it stayed there. Perhaps slags from other smelters do compact somewhat; Anaconda slags do not.

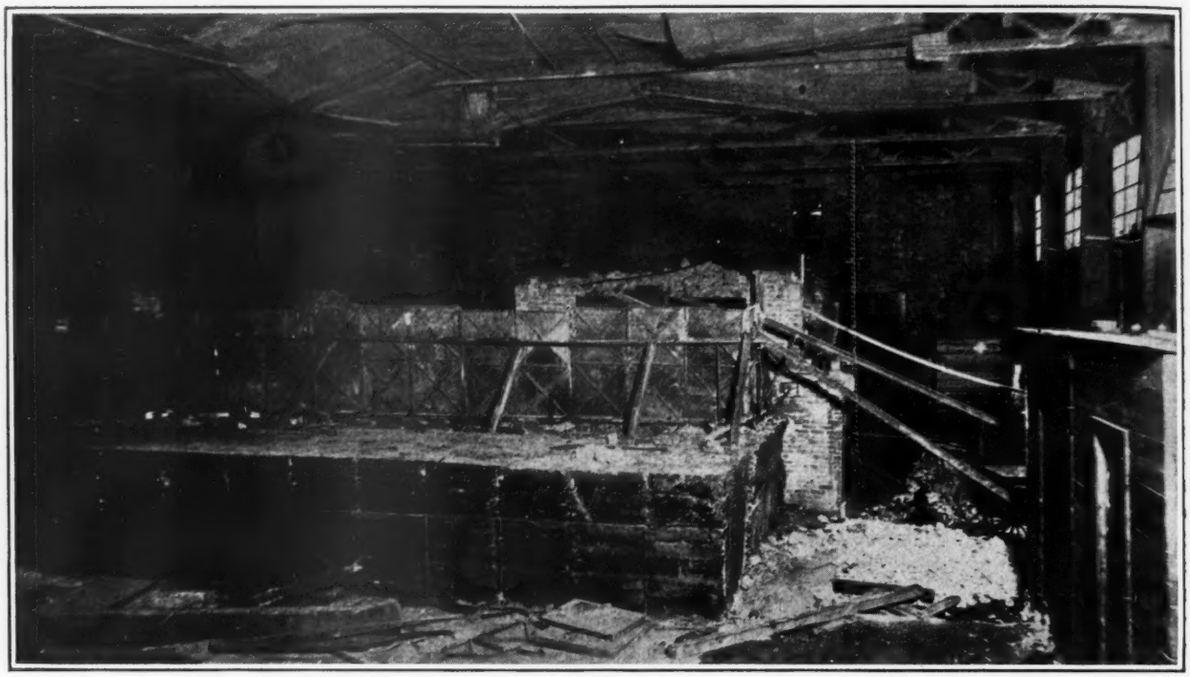
Slag has been proposed many times for coarse concrete aggregate. Some slags make a good bond with cement mortar. Others do not. This is a point to be determined for each circumstance. If the slag produces briquets of satisfactory strength, the main difficulty will be found in crushing the solidified slag. (A minor point, except for reinforced buildings, is that the specific gravity is high—slag concrete weighs more than sandstone or limestone concrete.) It is possible, of course, to blast out a section of an old slag dump fairly cheaply, but the slag itself is so hard and "sharp" that it rapidly ruins all handling and crushing machinery through which it passes. Therefore, when the total cost is finally figured, the expense of keeping the machinery in repair more than overbalances the cost of preparing crushed rock from a near-by quarry, or of washed gravel from a pit. Table I shows an estimate of the cost of this slag in 1914 taken from a dump in Great Falls, especially suitable for making coarse aggregate.

Table I—Estimate of Cost of Loading Slag for Concrete Purposes, Great Falls Smelter; 1914

		Cost per Ton
Drilling		
10-ft. holes at 10-ft. centers break 1,000 cu.ft. at 220 lb. per cubic foot. One hole therefore breaks 110 tons.		
Drilling 10-ft. hole at 51c. per foot costs $5.15		$0.047
Blasting		
Blasting costs 11.3c. per cubic yard. 1 cu.yd. solid slag weighs 2.96 tons		0.038
Loading by locomotive crane		
Average performance: 193 tons per eight-hour shift.		
Cost: Craneman	$4.00	
Boy	1.75	
Power	2.77	
Repairs	6.10	
	$14.62	0.076
Switching to screening bins		
$1.50 per carload of 55 tons		0.027
Screening		
Two men at $3 screen and load 5 cars.		
Labor	1.8c. per ton	
Repairs	1.0c. per ton	0.028
Total		$0.216
Weight of broken slag: 112 lb. per cubic foot or 1.51 tons per cubic yard		
Total cost per cubic yard		$0.325

In this particular location, no crushing was necessary, as the slag had run out and solidified in sheets less than an inch thick. Correct blasting and the handling operations employed produced few large slabs. However, a fairly large part was screened out and wasted as fines. Combine this with the extra wear on bins, concrete mixers, and all handling equipment, and it may be appreciated that even the 35c. apparent cost was not very attractive in competition with good gravel at 75c.

One special use of copper furnace slag in construction work may be of interest in this connection—namely, the use of pieces of hot slag as rubble when pouring



Completed slag block below. Iron plates set for forms for second lift

concrete in the winter time. This idea was extensively used at Great Falls during the reconstruction of the smelter, 1912-1914.

As is well known, Montana winters are quite severe, but it was necessary to push construction operations despite this fact. A great deal of preparatory work consisted in making concrete walls approximately 12 in. thick situated in the open. Having a good plant for supplying thawed sand and gravel and hot water to the concrete mixers, it was found that concreting could be carried on successfully and quite efficiently so long as the temperature was above zero, if as much hot slag rubble were put into the thin walls as the mixture would conveniently carry. This rubble consisted of broken slag skulls, allowed to solidify until 2 in. thick, fresh from the pot, so hot that asbestos gloves were required to handle it. This heat reservoir eventually warmed the entire mass and speeded the set so that a thermometer placed under the burlap covering on a 12-in. wall cast twenty-four hours previously in zero weather would still register 40 deg. F. Thus, all danger of frozen concrete was avoided. The only disadvantage was found later: when an attempt was made to drill holes into this concrete it was found that the slag chunks successfully turned the point of any drill bit which the blacksmith shop could produce. At present such holes would be pierced with an oxygen torch, so even this would not cause any trouble.

From the above the conclusion may be drawn that copper blast-furnace slag, crushed or granulated, is of little or no value. Only in the rarest instances may it be used with profit. Molten slag is in fact of more use than all of the above combined, when it is desired to build massive foundations near enough the furnaces so the switch tracks will not cost too much money.

Use of slag to build foundations has been described briefly in the mining press from time to time. If I remember correctly, at least one of the smelters in the Southwest has a chimney which rests on a large mass of slag cast into a hole in the ground. This same scheme was used in partly filling very deep piers dug to bedrock in the reconstructed smelter at Great Falls during the winter of 1912. The cost of such filling was very small indeed, as the sides of the excavations served for form work, and the location was such that slag by the potload could be poured into the hole either direct from a crane or through a relatively short launder.

Building Reverberatory Foundations

Another more interesting piece of work was the building of a large block of slag, approximately 100 ft. square by 12 ft. high, for the foundations of the new reverberatory furnaces. This was built above grade, so it was necessary to erect retaining walls of some sort to hold back the slag. Experience had taught that a concrete wall was unsuitable for this purpose, since even though the concrete had been in place for weeks and had thoroughly set there was still enough moisture in it to cause excessive spalling when the hot slag hit it. (Concrete piers therefore had to be faced with brick work). Furthermore, the expansive action of the heated inner surface, rather than the hydrostatic action of the liquid slag itself, would always tilt even a very heavy wall body out of plumb. Even the most substantial bracing was powerless to prevent this movement—the wall would seem to lift bodily, moving in an arc about a center represented by the foot of the bracing. It may also be said that this movement and shattering of a wall was worst where only a portion of the wall was heated at one time. Consequently, the wall should be built with expansion joints corresponding to the blocks of slag to be cast against it. It is much better to build slag with temporary forms and then face it with a fairly thin concrete wall, just for finish. This method was under way when the pictures illustrating this article were taken.

To do this work, a number of old cast-iron floor plates were secured, about 2½ ft. by 5 ft. in area, 1 in. thick, and ribbed on the bottom. A suitable place was marked out, one end of which was accessible to the slag ladles,

either directly or by a short launder, and of an area such that a full ladle of hot slag would fill it about 4 in. deep. Thinner layers than this were avoided in this construction, because it was found that at least that much liquid slag at one time was necessary, so that the top surface would run out level, and also to prevent loose slabs and much vertical cracking. No fusion of the underlying layer was apparent, but successive layers should be cast without delay of more than an hour. In the larger areas, two or more potloads were poured without interruption.

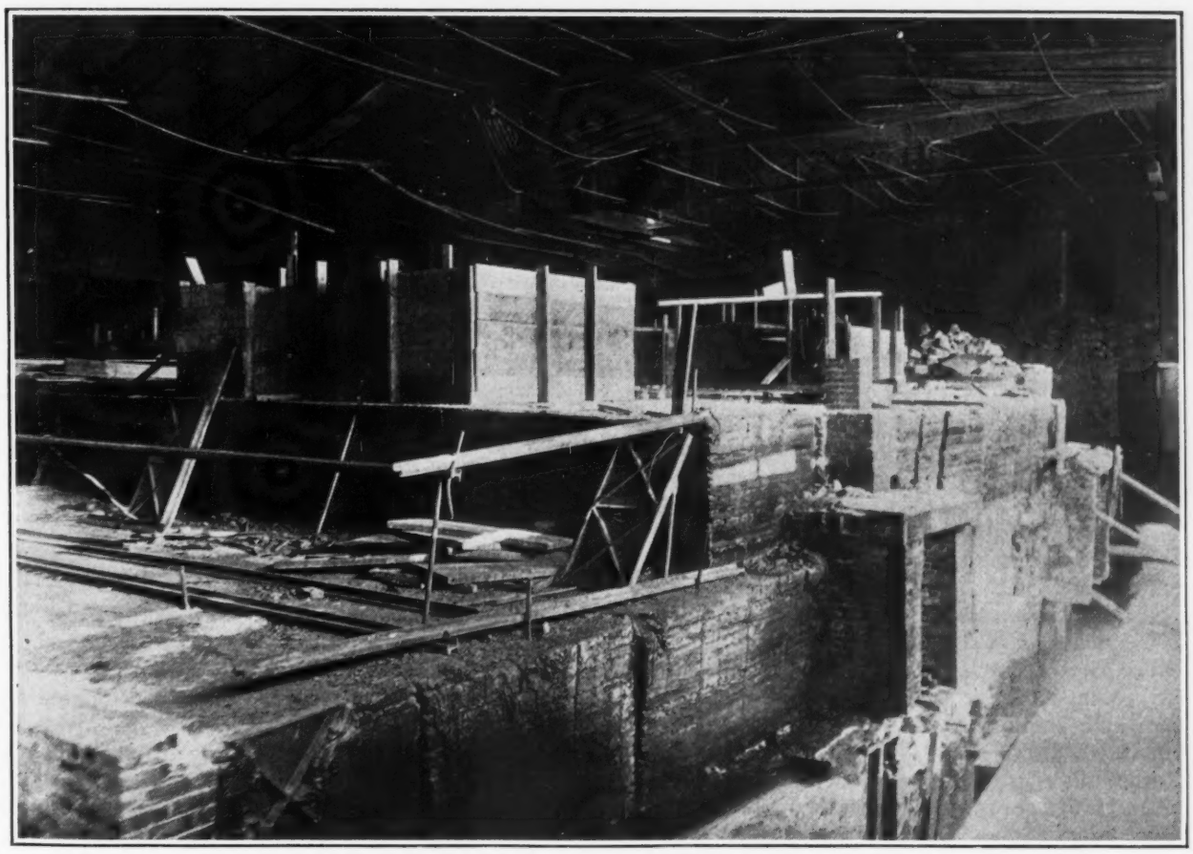
With hot, fluid slag a difference in elevation of less than 1 in. in 25 ft. may be obtained. Furnace conditions have something to do with the temperature of the slag, but it was found on this work that the best slag for pouring had a ratio of acid to base of about 1⅛:1. It analyzed: silica, 37 per cent; iron oxide, 27; alumina, 6; and lime, 27 per cent.

As shown in the illustrations, floor plates were placed on edge in a continuous wall. Steel dowel pins were driven in the floor, both front and back, to fix the bottom of the plates, which were also held vertically in position by inclined posts and horizontal rails at the back, or, where this was impossible, by steel wire ties running diagonally to the floor toward the front. The method is clearly shown in the picture. Carefully made, such a wall was quite smooth and tight, so only a little clay was required to mud up the cracks between the plates and around the bottom. It was necessary, however, that this work be substantially done, because, as is noted, the liquid slag (even when cast at such intervals that the lower layer chills before the next pot is poured) exerts a fairly strong pressure against its confines.

Cast-iron plates are about the only thing which is usable, since steel warps badly and is so light that it will float away unless carefully anchored. Concrete and brick are too expensive except for finish, and even these must be placed *after* the mass is cast, for the reasons noted above.

In this work it was found that a crew of two intelligent laborers could prepare one area during the day shift large enough to take all the slag which could be conveniently poured into it during the night. The next day the plates would be moved to a new location. The only other preparatory work necessary to get the slag into position was to protect the wooden roof from catching fire. This was done by placing corrugated iron sheets loosely along the plane of the bottom chord of the roof trusses.

In the table on p. 288 it will be seen that an item amounting to 6c. per cubic yard is due to the special circumstance of working under a low roof. Labor and material for the forms is as low as can be expected, since the men worked steadily, and the charge for cast-iron plates was low. No charge was made for a large quantity of scrap rails and bar which were used. The craneman was idle most of the time—dumping slag pots at intervals of an hour; so this item could be reduced on a larger job. Breaking skulls amounted to a big item, because the Great Falls smelter at that time was granulating all slag direct from the furnace and no means was available of loading the skulls out on cars to a dump. On a large job in the open, therefore, these



Preparations for setting iron plates for new block in second lift. Wooden forms for concrete foundations to be embedded in third lift. Note brick chimneys providing holes through slag mass. Also note method of protecting wooden roof sheeting from radiating heat.

costs could have been reduced perhaps to $1 per cubic yard, but if the site were difficult to reach or required special trackage or equipment the cost might readily have been considerably greater.

This block of masonry was therefore constructed at a very modest price. Cost data follow in Table II.

Table II—Cost of Building Slag Block Containing 3915.7 Cu.Yd.

			Cost	Cost per Cu.Yd.
Preparatory work				
Building and placing special launders		$484.46		
Less credit for scrap		118.73	$365.73	$0.09
Protecting roof: labor and material			227.18	0.06
Metal forms for slag work				
	Days			
Foreman	23½	98.73		
Team and teamster	1⅛	10.87		
Laborer	396½	1,275.12		
Shop labor	12⅞	47.97		
Shop maintenance		24.36	1,457.05	0.37
Bar and drill stock		45.31		
212 cast-iron floor plates; 290 lbs. each		1,260.30		
Less credit for 35 returned		Cr. 197.63	1,107.98	0.28
Casting slag				
	Days			
Craneman	83½	351.51		
Labor	49½	158.24	509.75	0.13
Breaking and removing slag ladle skulls				
	Days			
Foreman	19½	79.23		
Team and teamster	59½	362.93		
Laborer	243½	776.44		
Craneman	34⅛	143.33	1,361.93	0.35
Total cost		.....	$5,029.62	$1.28

The foundation under the reverberatories at Great Falls has, so far as I know, proved entirely satisfactory. After the furnaces were in operation it was found that the slag mass was apparently growing in size, expanding as the heat of the furnace worked down into the underlying material. This growth caused considerable moving and shattering of the concrete facing walls, which movement continued for several inches. Growth of this sort eventually amounts to much more than the expected movement figured from differences in temperature, probably because the hot slag, when it cools off between furnace campaigns, instead of contracting to its original position will crack open. If these cracks then get blocked by broken bits falling in from above, subsequent expansion will cause the mass to appear to grow bodily because the cracks are not able to close. This feature is not a special objection to slag foundations. Such movements under large furnaces are to be expected no matter what the foundation, and should be provided for in the design of the plant (especially the building column footings), since it is impossible to stop them.

Fairly large movements may be expected in any solid rocklike foundation, but lesser movements are always observed in foundations of sand or loam. Witness a considerable shattering in the retaining walls at the front and rear of reverberatory furnaces at Tooele, Utah, founded on earth.

Leasing Mineral Lands in South Africa

In commenting on the coal situation in England, and the suggestion that the coal mines should be acquired by the British Government and leased on a royalty basis, a writer in *The Economist* describes a method of leasing mineral lands that has met with success in South Africa. A large area to the east of the Rand, which is Government property, has become available for leasing, and a scientific plan has been introduced, chiefly through the efforts of Sir Robert Katze, the Government Mining Engineer. This is based upon the principle that the body of capitalists who undertake to exploit the gold ore known to exist on the land should have a reasonable prospect of making customary profits, and should be encouraged to do their best by the hope that profits may be somewhat above the average; but that if the ore should turn out to be particularly rich, the benefit should accrue to the owner rather than the exploiting company. With this aim, an estimate was first made, on the basis of what was known of the geology of the district, of the yield to be expected and the cost of working; a lease was then offered, according to which the rent paid to the Government was to be a percentage of the profits made, the percentage rising as the profits were larger. After some experience, a suitable relation between the two quantities was found, and was embodied in an algebraic formula, which is now an integral part of the leases; in the case of land put up more recently, the tendering consists in stating what constants the tenderer is willing to insert into the formula.

The formula is $y = a - b \div x$. x is the percentage ratio which profit bears to gross income (after allowing for amortization of capital) and y is the percentage of such profit to be paid to the State. a and b are constants offered by the tenderer.

However, it is possible to understand the method even if one is ignorant of algebra. To take the lease of West Springs as an illustration: this is arranged so that, if out of the gross proceeds of the gold extracted not more than 10 per cent is profit, no rent is payable. If the business turns out more fortunate the rent rises, rapidly; with profits 25 per cent of gross income, rent is 39 per cent of profits; with profits 50 per cent of gross income, rent is 52 per cent of profits, and so on. To carry out such a plan it is necessary that accounts be kept very strictly in accordance with a prescribed system, and that the term "profit" be carefully defined.

The essential feature of the East Rand lease is that it retains for the state as much as possible of the natural value of minerals. A rougher plan does not secure this. The assumption of risk by the exploiter will probably lead to the royalty offered being less than the true average value of the mineral rights; but, even if it were equal to that average, in practice the Government's receipts will be less, for if the mine is unsuccessful the owner has to reduce or abandon his royalties, while if it turns out to be exceptionally rich the owner gets nothing additional.

Rhodesian Asbestos Industry Expanding

A statement prepared by the Standard Bank of South Africa, Ltd., shows a considerable increase in the output of asbestos during 1925 compared with 1924, the product being valued at £152,115 in 1925 compared with £110,075 in the preceding year. The demand was good and the mines were not always able to take care of all the orders received.

The main difficulty confronting the asbestos industry in Rhodesia has hitherto been lack of transport facilities, but in view of the approaching completion of the railway to Shabani, the outlook for the industry is considered bright. Additional producing companies are expected to increase the total production.

The Underlying Principles of the Limestone Replacement Deposits of the Mexican Province—II

By Basil Prescott

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THE FIRST PART of Mr. Prescott's article appeared in last week's issue. In it he discussed the application of the underlying principles to the Santa Eulalia district. Continuing, in this concluding installment he first considers the Ojuela, Mapimi, and Durango districts.

Ojuela is one of the famous silver-lead-zinc camps of northern Mexico, and, although not so old nor so well known as Santa Eulalia, it is in many ways even more remarkable, and as a single-mine metal producer, has a record that has probably never been equaled in the province by this type of deposit.

In the case of Santa Eulalia, the application of the given underlying principles was considered for a district comparatively free from structure and faulting, where the limestone is nearly horizontal, where selective action of the beds is rather pronounced, and where fissures are abundant and readily grouped; in fact, the simplest, easiest, freest from complications of all the limestone districts of Mexico.

Ojuela, on the other hand, lies in an intensely disturbed region, where the structure is extremely complicated and contorted, pre-mineral faulting prevalent and severe, overthrusting common,[3] and the selective action of the beds a minor factor limited to certain definite individual beds, but where an example of nearly every variation in form, habit, and mode of control shown by an orebody, in any district of the province, may be found well developed and clearly illustrated.

In this camp, the principles stated are and have been so universally accepted, so thoroughly tested, and so well confirmed that it is a matter of surprise to the engineers and operators there that similar conclusions have not been invariably reached in other limestone districts, and this explanation and apology are required before stating the obvious.

The section at Ojuela cannot be so readily correlated with the generalized section given as is the case at most of the camps that lie further to the east. It is similar to the column at Naica and resembles that of the few limestone mountains that outcrop among the Tertiary eruptives west of the line of the Central Railroad of Mexico. Progressions and transitions could probably be established were it not for the volcanic capping, and might be accomplished, even under present conditions, by a careful, competent observer.

At the base of the sedimentary column the usual sandstone is found, exposed along the western edge of the range in which mines occur, though a drill hole from the bottom workings shows an igneous rock at depth, which J. E. Spurr determined to be alaskite. Perhaps a thousand feet of sandstone is exposed, overlain by a transition zone through interbedded shales to dark shaly limestone and finally to pure limestone. No accurate determination of the thickness of the limestone has been made, as far as is known in the camp, but an estimate may be given of six thousand feet or more. Toward the center of the section, two shale bands occur, from one hundred to two hundred feet thick, separated by some three hundred feet of limestone. Many of the beds are distinctive, as are the sequences, and this has proven useful in working out the structure and solving the faults.

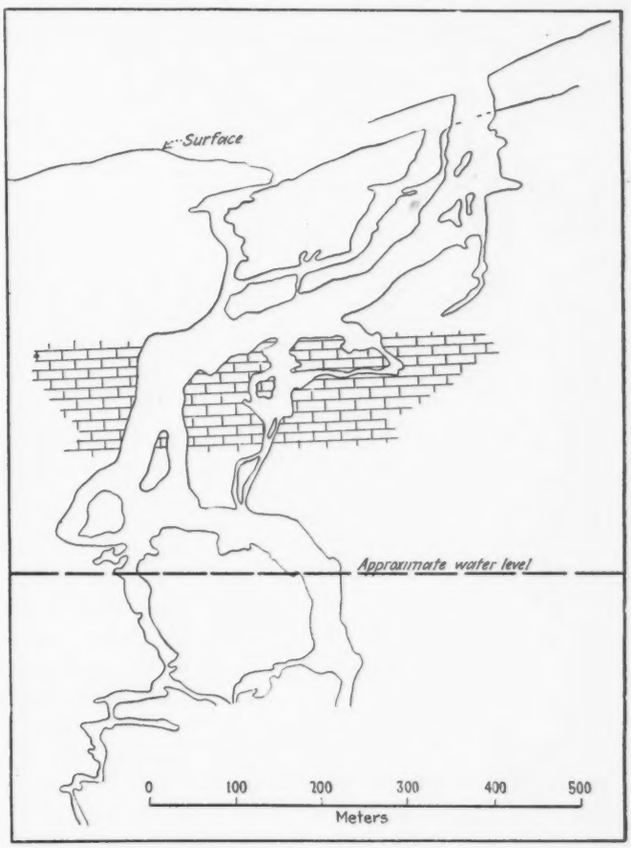


Fig. 8—Ojuela mine, Mapimi, Durango. Ojuela-Paloma orebody. By permission of Cia. Minerva de Peñoles

Intruded into the sedimentaries are irregular bodies of igneous rock of intermediate types, accompanied by metamorphic silicates, which, though they are probably genetically connected with the orebodies, are not physically associated with them and occur chiefly to the north and east of the mineralized area. In the heart of the range, near Dinamita, a great mass of granite is exposed by deep cross-erosion.

The structure, as already noted, is quite complicated and has been the subject of much discussion and controversy, none of which is pertinent to the consideration of the underlying principles controlling ore deposition. The limestone has been contorted into a series of folds, striking northwest-southeast, accom-

[3] J. E. Spurr: The Ore Magmas, Vol. I, pp. 202-214.

panied by some overthrusting, and separated one from another by parallel faults that stand at high angles and have movements with vertical components of at least one hundred meters each. The resulting structure is beautifully exposed in a deep cross-canyon and, as in most of northern Mexico, the absence of vegetation enables a closer study of conditions than is usually possible in other parts of the world. One very prominent post-mineral fault, the San Diego, striking N. 10 W., with a movement of only a few meters, is well outlined by development, owing to its having been a channel of secondary action and a guide to watercourses, and numerous minor offsets of different strikes are encountered in the mine workings.

The orebodies occur in the limestone that underlies the shale bands and outcrop on its surface where the shales have been eroded. In a few instances they reach the shales and mushroom slightly under them, and occasionally uneconomic mineralization passes through the shale and is found well up in the overlying formations.

Individual chimneys are much more numerous here than at Santa Eulalia, though they do not throw off so many long, clearly defined mantos and branches. The mineralization is the typical mixed sulphide of galena, sphalerite, pyrite, and arsenopyrite, with silver and some gold, and the resulting carbonate-oxide mixture where oxidized. A little copper is found with depth. As at Santa Eulalia, traces of silicates are found with the gangue of the sulphides and appear to increase with depth, being quite prevalent in the ores now being mined around Contra-Tiro No. 1. In contradistinction to Santa Eulalia, which has no real water level as yet, Ojuela has cut below the twelfth level very heavy flows, estimated at six thousand gallons per minute. The actual water level fluctuates considerably from year to year and apparently stands much higher now than at some earlier date, as the oxides extend down below water level for at least fifty meters.

The mines are opened, in general, to a little below the twelfth level, a depth of eighteen hundred feet below the highest point of the strong outcrops; but one group of orebodies has been followed to an additional depth of about one thousand feet without appreciable diminution in grade or size, other than can be accounted for by differences between sulphide and oxide, developed during oxidation.

The orebodies are very numerous, and it is not possible here, as it was in Santa Eulalia, to give a general description of them or their occurrence. Each has marked individualities, not only in constituents and metallic ratio, but also in form and habit, position, and guiding control, so that an idea of the situation can best be conveyed by a description of several examples, selected from a great number of orebodies, to show the wide range of occurrence.

Case I—Simple Chimney Crossing Strata. Ojuela-Paloma.

The Ojuela-Paloma orebody is given as an example of a simple chimney cutting through nearly horizontal beds at a strong angle. A vertical depth of just under three thousand feet has been developed with no indication of weakness in the bottom, the diminished cross-section below the twelfth level marking the change from porous oxides to solid sulphides on the water level. The accompanying projection shows quite clearly the continuity (Fig. 8); and although a volume relation cannot be established from a single plane projection, it may be noted that, in spite of great irregularity, branching, splitting, and reuniting, the sum of the pipes at any horizon approximates a constant. A composite plan would be confusing, while level maps would show the marked irregularity of the body and that it does not occur on any single fissure or set of fissures, but rather that the outlines of the orebody and the position of the fissures on any one horizon bear only a slight relation to similar plotting on some other horizon.

The body then represents a meandering chimney without definite control by either fissures or beds.

Case II—Chimney, Manto and Chimney. San Jorge-San Juan.

The San Jorge-San Juan orebody starts at its present deepest development as a chimney following a pre-mineral fault of approximately one hundred meters' vertical displacement. The fault stands vertical and has a relatively straight strike and at many points is filled with post-mineral dike. As shown on the accompanying projection (Fig. 9), the orebody mantos about two hundred meters above water level and follows the limestone bedding and structure to the south, leaving the fissure well in one wall for about half a kilometer. The orebody then crosses the fissure and again chimneys to the surface.

Continuity and constancy of cross-section are both indicated on the projection. On water level, two main branches of the chimney are shown, and the analyses of these are markedly distinct, even though they are separated by only a few meters of limestone. If the fissure were the channel along the length of which the mineralization was introduced, it seems remarkable that the orebody should have left the fissure for the entire length of the manto and later crossed it without apparent effect on its course. Here again it seems quite difficult to separate the mode of introduction of the mineralization in the chimney from that of the manto, and we feel that the evidence points toward the ore found in the upper chimney having traveled through and inside the walls of the manto, and that this in turn came through the lower chimney.

Case III—Inclined Chimney and Flat Manto Guided by Structure. Cumbres.

The Cumbres orebody lies along or near the axis of a sharp anticline as shown in the accompanying plans (Figs. 10 and 11). From the water level up to the fourth level (Fig. 10) it consists essentially of a group of inclined mantos, each of which is in reality an independent orebody, with its own standard analysis and cross-section. On the fourth, the mantos, following the anticline, encounter a pre-mineral fault fissure striking at a slight angle to the axis of the anticline, and follow this upward for about one hundred meters, where the body mantos to the south and is followed with diminishing cross-section for at least half a mile. One would naturally infer that well-developed pre-mineral fissures would be found following such a pronounced structural axis; but as is so often the case when inferential reasoning and logic are tested in the field, the facts do not support the inference, and such fissures seem to be lacking. Again, the pre-mineral fault fissure mentioned as crossing the body at a slight but decided angle might have been expected to control the orebody from that point on, instead of allowing the body to diverge slightly and continue along the structure.

Case IV—Orebody on Beds on Limb of an Anticline. San Carlos.

The San Carlos orebody, below water level, follows a pre-mineral fissure, but on about the horizon of the twelfth level makes off on the beds, which are dipping at this point about forty degrees. The ore is spread out on the beds, not occurring in the usual finger-like manto form, and continues up the limb of the anticline to the surface. Carmen is the same type, in that it follows the beds on a structural limb, but for several hundred meters it cuts through them. Both are just as continuous as any other type and maintain fairly constant cross-sections.

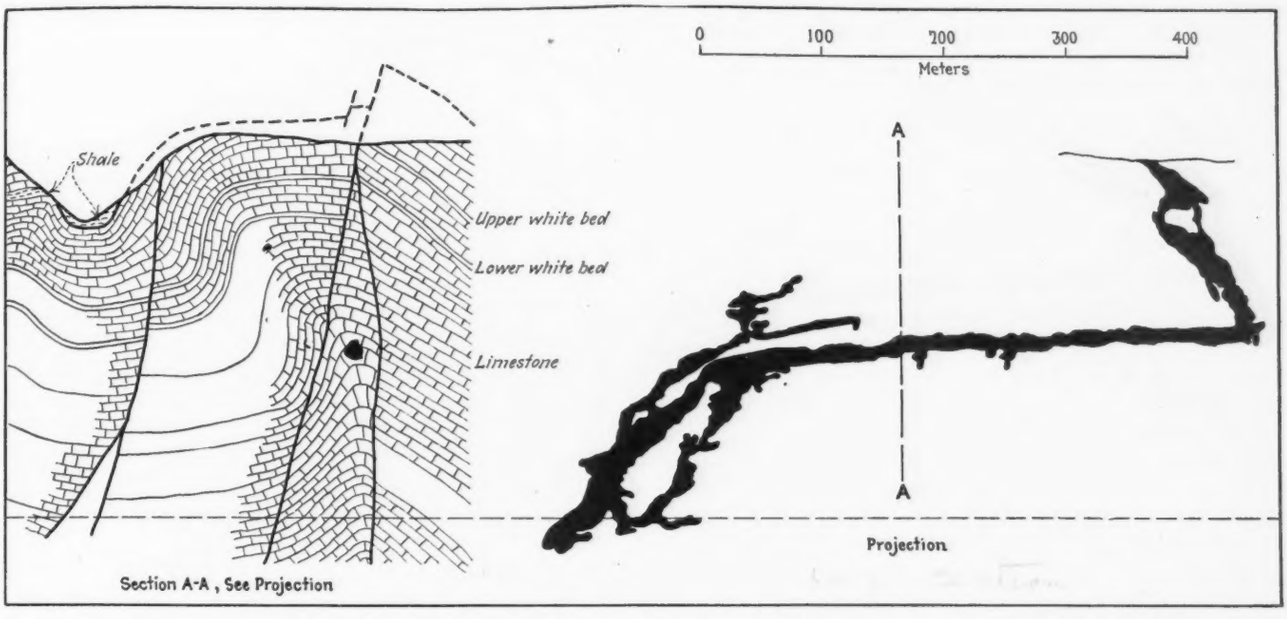


Fig. 9—Ojuela mine, Mapimi, Durango. San Jorge-San Juan orebodies. By permission Cia. Minera de Peñoles

Case V—Orebody Follows Fissures as Series of Vertical Pipes. Santa Rita.

The Santa Rita fault fissure is the locus of a number of pipes from the seventh level to the surface, almost vein-like in form. The fissure continues strong and well marked to the deeper levels; but the orebodies below the seventh level make off to the west, and manto on the twelfth-level horizon. Below that level they continue downward as chimneys in the limestone. We have here, then, an ascending mineralization which reverses the condition of San Jorge in that this finishes above on a strong pre-mineral fault fissure, whereas San Jorge starts below on such a one. Both show the basic indifference of the ore channels with regard to pre-mineral fissures.

Case VI—Controlled by All Types. San Diego.

San Diego starts as a strong manto below water level, crosses the post-mineral San Diego fault, mantos for one hundred meters more, goes up as a chimney for fifty meters, then follows the beds, crosses the San Diego fault, and continues on the beds, following faithfully the structure developed, a huge Z, and finally above the first level strikes the pre-mineral San Vicente fault, which it follows to the surface.

These are only a few of the many orebodies developed in this mine. There can be no question of their continuity from greatest depths reached, to the surface; nor of their falling within the limits of cross-section variation given. That they work upward from their source is obvious. Each orebody now being mined has a distinctive analysis, and the variation between one and the next is as great as between orebodies separated by the entire area developed. Sufficient data as to grade and analysis of the ores previously removed are not available to give the range and characteristics of this variation; but data on these points both in oxides and sulphides are being gathered.

That the orebodies are essentially chimneys or pipes seems to follow. The Ojuela-Paloma projection, for example, shows portions of the stoped-out chimney which lie horizontal for hundreds of feet that cannot be separated in mode of occurrence from the remainder of the vertical orebody, while the San Jorge upper chimney is unquestionably fed by the manto of the lower chimney.

Ojuela is an excellent district in which to study that phase of the process covered by our sixth proposition —that the course of a single orebody will be controlled by any combination of the factors: selective action of certain limestones, variation of composition, structure, posture of the beds, and pre-mineral fissures. Space limitations forbid elaboration. San Carlos shows the effect of the selective action of certain beds, usually dolomitic; the lack of ore in the shale bands shows the effect of variation of composition; the Cumbres orebody following the anticline illustrates the effect of structure; the San Diego where it follows the vertical beds shows the result of posture; and, while all the bodies show that the localization of the mineralization and the shapes of the orebodies are influenced by fissures, they also all show clearly that an orebody will abandon even a pre-mineral fault fissure of great strength and persistence for a meandering course through the country rock.

One very interesting and instructive point is clearly brought out by the Ojuela occurrence. With depth, the orebodies almost invariably approach simple chimneys in form, losing much of the irregularity that marked them above; and, when the inter-relation of these deeper chimneys is studied, as, for example, on the plane of

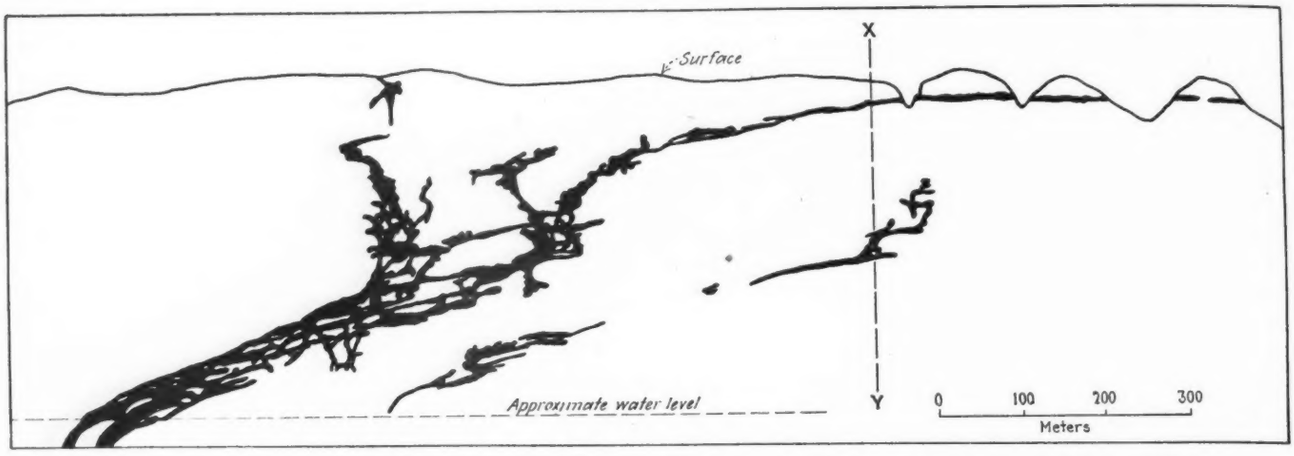


Fig. 10—Ojuela mine, Mapimi, Durango. Cumbres orebody. Projection N. 32° W., looking northeast

the water level, it is found that the orebodies occur irregularly spaced along two very definite and exact lines. The more important of these show this precise arrangement of the nearly vertical chimneys taking place along a line that bears little or no relation to the known structural features of the limestone, and the only fissure that parallels the arrangement of the chimneys is the relatively unimportant post-mineral San Diego fault. The least that can be said is that the localization of the chimneys at the points where they enter the limestone with depth is controlled by features existing in the underlying rock, not by the fractures and structures found in the overlying limestone. The post-mineral San Diego fault cuts all such structure and all pre-mineral fissures at an angle, and represents a readjustment along some geologic feature of the underlying rock, which feature had also some relation to the distribution of the channels of mineralization in that rock. The pertinent fact is that the chimneys actually appear at depth at any point of the structure, along a synclinal axis, along a limb, along an anticlinal axis, along a great pre-mineral fault fissure, between such fissures, and so on; and the shape and position that these bodies then assume, and the type of control they then follow, are entirely dependent upon the conditions that pertain at the point where they are released into the overlying rock.

Naica, Chihuahua

Naica is one of the smaller districts of the type perhaps more famed among the legal profession than among engineers; nevertheless, considering the shallow depth to which it has been worked—some six hundred feet—and the relatively small area explored, its production of over four hundred thousand tons of an excellent grade of lead ore is, at least, worthy of consideration.

In the cases of Santa Eulalia and Ojuela, camps were described in which the underlying principles were readily applicable and, at least in the conception of the great majority of the local operators, obviously correct. There are several other such camps in the province, but Naica is chosen as our next example because it is a camp where the ore was always believed to have occurred on fissures and, particularly, their intersections, to have shown no continuity in the orebodies, and to have fulfilled completely the "plum-in-the-pudding" type of occurrence.

The Naica ore deposits lie in a simple dome with its major axis striking about N. 30 W., resembling, in this, Santa Eulalia, though the dome at Naica is rather more pronounced than at Santa Eulalia, quaquaversal dips varying up to fifteen or twenty degrees from the horizontal. The area is intensely faulted, in which it resembles Ojuela, but the faulting here is both pre-mineral and post-mineral; and, in contradistinction to Ojuela, the faults strike and dip in every quadrant. Selective action of the limestone is almost negligible so far as developed, and most of the orebodies cross the beds at strong angles.

Little is known regarding the geologic column in the Naica district, as the mountain slopes roughly correspond with the dips of the strata, which, combined with the shallow depth of the mine workings, gives a very limited vertical exposure of the formation. Were it not for the compounding resulting from the major faults even less would be known, as the range is surrounded by rather broad valleys which make uncertain any attempt to build up the column by observations in the surrounding territory. It is known, however, that to the south the limestone is underlain by sandstone, as at Ojuela, which this section seems to resemble. The deepest limestone encountered in the mine workings is rather massive and somewhat marbleized, overlain by medium-bedded limestone up to a shale band occurring less than one thousand feet above the bottom. This band is perhaps forty meters thick, and is good, clean, easily recognizable shale. This is overlain by six or seven hundred feet of exposed limestone which dips under the valley wash and is probably overlain in turn, at some unknown distance up the section, by shales. Some fossil and chert bands are found throughout the section.

The explored area is traversed by a zone of mineralization striking N. 50 W. and strongly offset to the west at two points. In this zone occur several N. 50 W. fissures, practically vertical, some of which are filled with dikes of acid igneous rock, usually two or three meters wide, though quite discontinuous, and often accompanied by sills and various irregularities; and with these dikes is a development of metamorphic silicates, chiefly vesuvianite, as narrow, discontinuous, irregular bands. At times these silicates are found to the exclusion of the dike, while the dikes are often found without the accompanying silicates, and very rarely are the sills so accompanied.

The orebodies occur in this same zone, usually near the dikes, but often at some distance, and it is felt that though they quite probably have the same origin and source, and have been controlled and guided in some instances by the same lines of weakness, they are not contemporaneous nor directly interdependent; in fact, the whole igneous expression is neither of a force nor a character that would lead one to develop such an idea. The ore is of two types, the first a typical oxidized silver-lead-zinc carbonate ore, down to the level of the water, where mixed sulphides occur, and below which development has not yet progressed. It is believed that the gangue of this ore contained silicates, though, in its oxidized condition, it is not always easy to make out the actual mineral, and they are certainly lacking in many instances, particularly in the upper parts of the mine. The second type is developed on the lower levels in the Descubridora claim of The Naica Mines of Mexico and at several other outlying points, and consists essentially of a mass of garnet with abundant wollastonite and some vesuvianite, containing disseminated lead and zinc sulphides with a minor amount of chalcopyrite. To date, these bodies have not been of great commercial importance, and the following description will be confined to the standard ore of the first type.

The area is cut by numerous faults, some of which are pre-mineral, some post-mineral, and others unquestionably of both periods; that is, reopened after mineralization. It is impossible within the limits of this paper to cover the detail of this fault problem, though it is interesting and instructive; but an attempt will be made to show that, when these faults are solved, the camp of Naica will cease to represent isolated "plums" and will prove to be a series of chimneys continuous from water level to surface.

In the Maravillas claim of The Naica Mines of Mexico the orebodies are unusually numerous; in fact, a single pertenencia of this group has produced over 50 per cent of the total production of the camp to date. In general, these orebodies are a series of independent chimneys that were followed from water level upward for seventy meters, to just above the second level, where they encountered a fault striking N. 50 W., parallel to the zone in which the chimneys occur and dipping to the northeast at about forty-five degrees. At this point they are cut off and faulted normally some twenty-five meters. From this position they continue as vertical chimneys to the surface, near which point they are again faulted by a fault with the same strike, but opposing dip, back into the mountain, and again are followed upward as continuous chimneys. With the exception of a few dislocations by the transverse faults, no great difficulty is experienced in following the orebodies except at these indicated points, but, as is so often the case in limestone, where no obvious markers exist the faults were overlooked, and, as a result, it was considered that some of the orebodies played out with depth, while others did not continue through to the surface. In the San Vicente mine of the Lepanto ground, and the Descubridora section of The Naica Mines of Mexico, the prevailing faulting system strikes N. 70 to 80 deg. E. and dips 45 deg. toward the north. One orebody, a large, strong chimney, is followed continuously from the surface to the water level with the exception of a small unmined segment now being developed, but before the faulting was taken into consideration this chimney was apparently three independent orebodies or "plums."

In the immediate vicinity of this same practically vertical chimney, an inclined manto occurs, which is in all respects similar to those described at Ojuela. From the point at which it turns into sulphide below the fourth level of Lepanto up to the third level, it is controlled by a strong N. 50 W. fissure, and as its height is at times greater than its width, it has the appearance then of a fissure orebody. Just above the third level, however, it turns off to the east with a full-sized cross-section, following one of the faults, and on the second level encounters another N. 50 W. fissure, which it then follows upward to above the first level. At this point, owing to some hasty mining done during the revolution, the body was caved while still in ore, and it remains unworked from that level to the surface.

Several points in the history of these two orebodies will bear emphasis. At the third level they are not far apart and occur practically on the same fissure, but they diverge both upward and downward, and both leave that fissure for another. One is controlled, over at least a part of its course, by a fault which dislocates the other, but it seems evident that both are chimneys, even though one is sufficiently inclined to be called a manto.

Along a certain cross-fracture, called the Torino, there are found on the lower levels two or more orebodies which seem to be controlled by that fracture, but on the upper levels these same orebodies leave the main Torino fracture and make up vertically through the limestone as chimneys. The fault already mentioned as striking N. 50 W. and dipping to the southwest cuts one of these bodies and dislocates it, just on the zero level, where the body is known as the Plaza Grande, but the cut-off is plainly marked and easily traced, and no difficulty was experienced in picking up the faulted continuation, even though the displacement—forty meters—was sufficient to make this continuous chimney appear as two independent orebodies.

We believe, therefore, that there is no phase presented at Naica that is contrary to the principles stated and accepted by the operators at Santa Eulalia and Ojuela, that the orebodies are continuous from the surface to the greatest depth reached, that their cross-sections are more or less constant, that the progress of

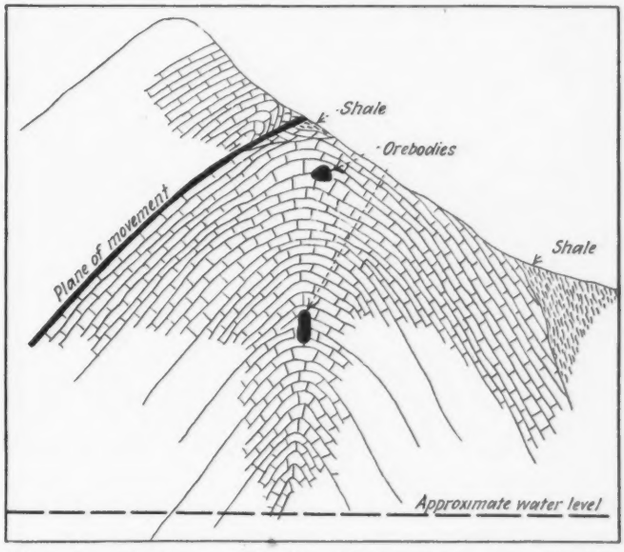


Fig. 11—Cumbres orebody, Ojuela, Durango. Section through line X-Y. See projection

the mineralizer is upward, that the analyses are uniform, though records do not permit observations as to their distinctiveness; that they are essentially chimneys, whether vertical or inclined, and that their course is controlled by the same factors—in this case, chiefly fissures. They do not, however, follow any single fissure, nor could any fissure have provided the mineralization as it occurs.

Other Occurrences

At Avalos, Zacatecas, in the Providencia mine of the Compañia Minera de Peñoles, the standard section occurs standing on edge and the mineralization follows the massive bed near the base of the section. As the beds are on edge, the ore occurs as chimneys, which are continuous from the greatest depth reached through to the surface, about seventeen hundred feet. No question arises here as to mode of occurrence, but the uniformity of cross-section is well illustrated, as is also the uniformity of assay, and in several instances individual chimneys may be distinguished by their analyses.

In T. A. Rickard's article on the Ahumada Lead Company, a plan and section are given, showing the mine workings; and though Mr. Rickard's conclusions were that the ore might be found scattered throughout a zone some fifteen hundred feet wide, the given map clearly shows the continuity and uniformity of the manto over a very long distance, in fact from the surface to the point reached by exploration at the time of his visit. It was the application of the underlying principles given here which led to the prediction, at a time when little more than the outcrop was known, that the orebody would extend continuously without interruption, other than minor faults, for at least a mile down the dip of the bed; this in spite of the fact that at the time of that examination there was no face in ore in the direction indicated. This great manto did not continuously follow any single fissure, as is shown by the mine maps, and is clearly a chimney lying at 14 deg. from the horizontal, fed at the lower end, outcropping on the surface at its upper end, and without accession of mineralization en route.

At Minas Viejas, Nuevo Leon, occur a series of deposits in the upper measures of the limestone, some of them on fissures, some along the axes of certain anticlines, and some in the relatively flat-lying limestone near by. One particular area was considered as illustrating the occurrence of an orebody at the intersection of fissures, but on investigation it was found to be a manto, quite continuous, but with an appreciable change in size on and past each one of the great transverse fissures crossed. At first this gave apparent evidence that the body received an accession of mineralization from each fissure, but when studied further it was found that the lower end was larger, and that its section was smaller after crossing each successive fissure; and, further, that the mineralization in these cross-fissures was confined to the area above the manto, while below the manto they were tight and "dry." We have here then a case of a flat-lying manto being the feeding pipe giving off a little mineralization upward on each of the pre-mineral cross-fissures, without any of them affecting the course of the manto itself, which crossed them without deflection. This unique occurrence seems most indicative and enlightening.

At Cigarrero, Sierra de Almoloya, Chihuahua, a single orebody is worked from the surface to a depth of about fifteen hundred feet, and, except where cut by a fault, is continuous and of normal cross-section throughout. This is an interesting case, for the orebody starts from below as a vertical chimney for some six hundred feet, then follows as a horizontal manto for several hundred feet, turns vertical for two hundred and fifty feet, and then turns back at a sharp angle and continues as an inclined manto with very true strike and inclination for perhaps a thousand feet, until it reaches the surface. It would be interesting to have some exponent of the older theory plot the feeding fissure responsible for this deposit.

Instances could be cited ad infinitum, from the Rio Grande to Guatemala, and, should occasion arise, several excellent examples in the western part of the United States could be given.

Consideration of Remaining Principles and Rôle of Fissures

Each of the six main principles has already been covered as fully as the limits of time and space will permit. The seventh proposition—that the first good limestone encountered is unusually productive — is dependent on a number of factors, such as temperature and pressure, as controlled by depth below the surface and distance from the igneous rock, and, in consequence, it must contain many modifying phrases.

In the province here considered the Lower Fossil horizon, though seldom a hundred meters thick, has produced perhaps 50 per cent of all the tonnage to date.[1] It is only necessary to remember that at Sierra Mojada, Los Lamentos, Higueras, Avalos, and at many of the smaller camps almost the entire commercial deposition is confined to that one horizon, while in many other districts the same bed is by far the most prolific, to realize the remarkable concentration of metal values within the extremely narrow limits of a single bed. Naturally, the occurrence has been the basis of much speculation and some investigation, resulting in the rejection of any idea founded on chemical differences between this bed and the others of the column, and in the realization that the only discernible common factor in all cases is the position of the bed at or near the base of the limestones.

The corollary to the principle of continuity—that an orebody has not been worked out if, where last known, it still has a strong cross-section and is in favorable limestone—has considerable practical application, but, from its very nature, few citable examples. Most known orebodies in the province either outcrop on the present surface or come up against a capping of later rock, and while a certain general decrease in cross-section can usually be detected, this becomes marked only when the body can be followed for a great distance. Perhaps the best examples of the inverse ratio between size and distance from the source are the San Toy and Jean Cave mantos of Santa Eulalia, and the Cumbres-San Rafael manto of Ojuela. "Every orebody must end somewhere," and it is only natural to have this thought in mind when following a deposit upward and outward from its source. Some criteria are needed to distinguish between an actual end, where further effort in development would be wasted, and apparently just as complete an interruption, where further exploration will result in finding a continuation of

[1] The Lower Fossil horizon was so named by J. E. Spurr and first recognized by him as an especially favorable bed.—B. P.

the orebody, and experience seems to support the corrollary.

Fissures have an important place in the geologic history of these Mexican limestone replacement deposits. They control all dry caves and water-courses, and are the channels along which oxidizing solutions are introduced and along which the products of oxidation were removed. They are often planes of fault movement and are the most conspicuous, prevalent, easily plotted, and simplest of all the features encountered underground. As a guide to development, they are constantly and closely studied, for the amount and character of the secondary products which they contain are often the deciding factor in any such question.

As long as the process of primary deposition is considered to be strictly analogous to that accompanying secondary action, it is only natural that the fissures should be looked to as channels through which the mineralization is introduced and along which the mineralizer passed on. As we have attempted to show, the mineralization appears to work its way through the limestone very much as though it were a free agent, being fed through its own body, and, as such, follows any feature that may temporarily serve as control, and leaves such a feature for any other at will. We insist that the manto or run is not fed from below along the fissure, but from one end, and hence the orebody is only related to that portion of the fissure with which it is in direct contact, while the fissure may or may not persist below or above the horizon of the ore. The facts, therefore, do not seem to lend the slightest support to the basic hypothesis of analogy between secondary and primary ore-deposition, and we are forced to conclude that none such exists.

It has been long considered that the fissures found associated with every oxidized orebody must have had the principal rôle in the localization of the primary deposition, and their great size and strength in and around the orebody is often pointed out. This is a confusion of cause and effect. Fissures, in all the limestone camps we have investigated, are innumerable, and those that are found in the neighborhood of an oxidized orebody are often opened out and emphasized by the solvent action of waters impregnated with active salts derived from the oxidizing orebody, their size then being the effect and not the cause of the orebody itself.

We would be the last to deny that the pre-mineral fissures have been one of the factors that have served to guide the course of the orebody. No one familiar with district maps of limestone camps can fail to pick out the strikes of pre-mineral fissures from the beautiful patterns so often shown. The elimination of the fissures control is not the idea of the corollary stated, but rather that this rôle has been over-emphasized.

We have attempted to show that the pre-mineral fissures are infinitely more numerous throughout the limestone than are the orebodies, that in many instances these fissures have no relation to the localization of the main chimneys; that, even though fortuitously so related, the fissures are not in any sense of the word the channels along which the mineralization is introduced from below, excepting possibly for the distance along them covered by the chimney itself; that no replacement orebody in our experience is controlled by a single fissure throughout its entire course; that orebodies often leave a given fissure, sometimes for another, sometimes to follow a different feature and sometimes to wander without apparent control; that two orebodies seldom occur on the same pre-mineral fissure, and that, when they do in any exceptional case so occur, their analyses are distinctive. In general, we believe that they play a very minor though quite obvious rôle in primary deposition. Fissure veins occur in calcareous rock, particularly when they are impure and somewhat shaly, but they are then as distinct from the irregular limestone replacement bodies considered in this paper as though they had occurred in an igneous rock.

Practical Considerations and Theoretical Conceptions

The practical application of these principles to underground development has kept up production and prolonged the life of the majority of limestone districts in this province. Once the basic idea is accepted, a great number of apparent exceptions clamor for recognition and investigation—orebodies which apparently are local caves filled with ore completely inclosed by limestone, without normal connections or continuations as mantos or chimneys—and in the early days of our experience these deposits were included under the head of the "exceptions that prove the rule." We have now, however, reached a point where we are willing to admit the frailty of human effort to solve such problems, the limited scope and ability of our geologic knowledge, and the ease with which erroneous assumptions are accepted and used to guide fruitless exploration; in other words, to accept human limitation, but not to acknowledge the fallibility of the underlying principles. Too many orebodies have been picked up after their continuations have been intermittently searched for over periods often exceeding five or even ten years to admit the impossibility of following through the few that now remain undiscovered. The great gain comes from the faith and belief that sustained effort will yield the desired results, and particularly from the elimination of the stultifying effect of the acceptance of the "plum-in-the-pudding" conception, "occurring at the intersection of two or more fissures."

In the heading of this paper these orebodies were called "limestone replacement deposits," as they fulfill all the requirements and have all the characteristics of the ore deposits that have been known under that name for many years, exactly as the name "contact metamorphic deposits" covers another definite type of occurrence; but, as in the latter case, the name brings to different minds distinct conceptions as to the mode of their formation, so, with replacements, the acceptance of the name does not mean complete conformity with the theories popularly implied. These are certainly replacement deposits in the sense that they occupy the space formerly occupied by the limestone mass in which they occur without distortion or dislocation of the inclosing rock. No attempt will be made at this time to advance a hypothesis to fit the observed facts. The purpose of this paper is rather to present the facts to the engineer and operator, in the hope that they may find them useful in the zone and on the horizons with which they are interested: that is, within the limits of the occurrence of commercial ore deposits.

Economic geology, with the aid of allied sciences, seems to be on the eve of a great advancement. In order that this may be consummated quickly and accurately, it is essential that we first realize and freely

admit the weakness and failure of many of the present ideas when tested in the field, and acknowledge that we are groping for something better. Though it is the province of the geologist who has access to the library and the laboratory, and the advantage of frequent conference with the physical chemist and physicist, to evolve and consolidate this much-desired advancement, nevertheless the field engineer has his part to play in providing better and more accurate descriptions of the occurrences encountered, and, above all, in keeping these descriptions as free from bias and distortion, induced by early training in ideas that have ruled in the past, as is humanly possible. Let us realize that it is not the province of every field engineer to advance a complete theory of ore deposition each time he examines a prospect.

Lead-Zinc Chimneys in Limestone

By J. E. Spurr

IT IS MY OPINION that the preceding paper by Mr. Prescott is the most important single paper on economic geology, both from the practical and the theoretical standpoint, which has been published for many a long day. It breathes the results of carefully trained observation of field phenomena over a period of many years; and is in refreshing contrast from much current literature which smells of the laboratory and the application of theoretical dogma. As a record of observation and unavoidable conclusion the paper speaks for itself, and a very careful study of it is recommended. Mr. Prescott has thought best not to confuse this clear picture of fact with any statement of further deductions and general underlying principles. I should like to add a few remarks, however, as to these: indeed Mr. Prescott has especially requested that I do so, and in doing this I have the benefit of his personal letters to me on the subject, which fall in general line with what I shall have to say.

In "The Ore Magmas" I devoted a chapter[1] to the "Origin of Certain Ore Chimneys," in which I pointed out that the analogy of ore-magma invasion as fissure veins and veindikes to that of rock-magma invasion as dikes had its counterpart in the analogy of igneous rock pipes or necks with certain ore pipes or ore chimneys. I examined a number of cases of ore chimneys in various stages of development, in non-calcareous rocks. After analyzing the development upward of rock magma in domical uplifts into volcanic (igneous) plugs or pipes, I queried, "Now, if many mineral veins are veindikes, which have gained their position by forcing open earlier fault fissures of slight or larger displacement, through the intrusive or surgent potency lent the ore magmas by the gaseous tension of the constituents, should not the ore magmas also occur occasionally along rudely cylindered pipes or chimneys, having bored a way upward through the solid rock, without the advantage of strong earlier fissures?" Several Colorado cases, among them the Bull-Domingo and Bassick mines, offered a clear reply to this question. Pointing out that ascending plugs of volcanic rock showed evidence of having been preceded (at their upper tip) by a concentration of gases, of high disruptive and solvent power, I added: "If this is the case, is it not fair to assume, in the case of the Bull-Domingo and Bassick, an upworking column or plutonic plug of ore-magma solution, aqueous and gaseous, at whose top the aqueous-gaseous components similarly concentrated; similarly, that when near the surface (within a few thousand feet of it) the gaseous-aqueous caps broke upward through the crust, leaving the ore-magma solution, analogously to the lavas in the common instance, to follow? And the narrow cylindrical channels of the following ore-magma solutions showed that these were of limited volume, as they were limited in point of time."

Other examples of this type were cited, varying from the small cylindrical and often corkscrew pipe of clean ore ascending along a fissure, or otherwise, to the larger cylindrical pipe-area of rock which had been shattered in all degrees, apparently by gaseous intrusion and expansion, and filled by ore, which consequently, in accordance with the size and degree of the openings so developed, formed orebodies varying in nature from a sulphide-cemented breccia to a so-called disseminated deposit. Such a deposit, for example, is "The Patch," in Gilpin County, Colorado, and I am tempted to quote at some length my conclusions as to this:

"The regularly curved elliptical horizontal outlines of 'The Patch' agglomerate-pipe and its regular chimney-like downward extension, do not, in my opinion, lend support to the theory of an origin by the intersection of fissures; moreover, the map does not show any series of fissure veins there converging, while there are numerous areas of complex vein intersection shown on the same map, which have given rise to no breccia pipe at their intersection. The dynamic origin of this chimney seems to me, from all evidence, plainly a local one not exhibited elsewhere in the mapped area; and it seems to me plainly a blow-out of gaseous accumulations. The physical results are the same as in the Bassick and Bull-Domingo pipes—thorough shattering, brecciation, and in places such tossing and rolling around, and upward movement of jumbled blocks, that they become completely rounded, and embedded in the finer detritus (arkose) worn from their broken edges.

"The fact that by no means the whole of the chimney has been filled with ore shows that it was not the ore solutions, gaseous or otherwise, whose accumulation blew out the plug; but it was the *avant-coureur*, or gas cushion, as in Custer County. The ore solutions followed. Moreover, the two types of metallic sulphide stages, found as fissure-vein fillings of distinct age throughout this whole belt from Silver Plume to Boulder County, were also injected here; and also here separately, for Bastin records that there is little mingling between the two types. This affords a valuable insight into the ore history of the whole belt; for it shows that the two ore-magma stages did not depend entirely for their sequence on dynamic accidents such as the fault-fissuring; for in this pre-ore breccia chimney the ore-magma ascensions were of the same two definite succeeding stages as in the fissure veins, meaning that the impulse or initiation of each of the ore-

[1] "The Ore Magmas," Vol. II, p. 858.

magma upward migrations was in the magma below, just as it was in the case of the initial gaseous explosion which cleared the road. An accumulation of ore magma in the depths, in each case, till the necessary surgent potency—namely, the necessary gaseous-tension pressure—had been attained, sufficient to allow it to force its way upward, either along this breccia pipe or (as ordinarily) along slight fault-fissure channels to form veins, is clearly indicated—two periods of such ore-magma accumulation, separated by a considerable period of time as we measure it, but, geologically speaking, very close together. And when these ore-magma gushes did arrive, they were truly potent surgently, as is shown in the little Hubert chimney, which is an intrusive body of the second ore-magma type; and as is shown not only in the connected Hubert fissure vein but in a hundred other fissure veins as well—such, for example, as the Mendota."

As for the nature of invading ore magma, I concluded in the case of "The Patch," for example: "But the 'true filled breccia,' of which a drawing is given by Bastin, incloses in a blende-galena matrix angular fragments of rock so widely separated that it must be they were supported free in the sulphide magma when the latter was fluid in practically its present form of concentration, and that the sulphide magma was an intrusive magma. If you will examine the two largest fragments of gneiss on the sketch, you will see that they have apparently been split from one another by the blende-galena matrix. Therefore, the cavities which were filled by the sulphides were not—could not have been—pre-existing; they were synchronous with the sulphides, and formed by their intrusive force. The phenomenon is, therefore, identical with that described by myself in the Mendota and other veins at Silver Plume, where both the sulphide matrix and the included fragments of wall rock are similar to the Hubert occurrence. Only at Silver Plume the ore is confined to the fissure-vein, showing, as I pointed out, the intrusive character of the fissure-vein filling; and in the Hubert the same type of intrusive fissure-vein filling breaks locally, at a vein-forking, into an intrusive chimney, a difference of form only."

The ore chimneys which I analyzed above were in igneous rocks, soluble evidently with difficulty or not at all by the uprising ore magma; consequently the ore inclosed angular fragments of the broken country rocks; and the gas invasion which preceded the ore invasion had, in many cases, so moved and tossed around the broken rock fragments that they became rounded by attrition, forming a "conglomerate" pipe which frequently was only partially filled by the relatively scanty succeeding ore magma.

As to similar ore chimneys in limestone, I instanced in this connection one at Santa Eulalia, in Mexico, as follows:[2]

"Ore chimneys of argentiferous lead-zinc sulphides of considerable horizontal diameter (up to 100 ft. or more) are characteristic of the mining camp of Santa Eulalia, in Mexico. (See Chap. 7, VII, p. 316.) They have come up through limestone, and, unlike the examples which have been cited, are unusually tortuous, doubtless on account of the presumably easy solubility of the rock traversed. Such a chimney is shown in Fig. 169, projected somewhat to the plane of the section, so as to include in the section the whole of its corkscrew course. This pipe of ore, at a certain elevation, spread out far along a favorable limestone bed. Fig. 170 shows a projection, on a horizontal plane, of this flat portion of the orebody, showing that while the horizontal attitude was controlled by the bedding of the limestone (the limestone is not far from horizontally bedded) the linear extent was controlled by the prevailing vertical fracture system, the intersection of which with the limestone stratum produced the horizontal 'run' or 'shoot.'"

This Santa Eulalia occurrence is one of those which Mr. Prescott also figures and describes (p. 248). He has taken up the problem and followed it out with rare patience and balance, showing here and in many other lead-zinc ore deposits in limestone in Mexico common and invariable characteristics of such ore chimneys, and connecting horizontal shoots or "mantos." Such horizontal shoots, he shows, are essentially horizontal elements of inclined chimneys; that is, ore solutions (ore magmas) with strong inherent ascending power have been deflected by favorable beds, as well as by convenient fissures. for a while, until the impelling ascensive force reasserted itself, when the favorable bed was abandoned in favor of a renewed movement toward the surface. The phenomenon on a large scale is much the same as that of step veins[3] or the "flats and pitches" of lead-zinc veins in the Upper Mississippi district.[4]

He shows that each such chimney, though straggling and branching, has a fairly uniform cross-section when all the different streams at any one cross-section are counted—except that the total cross-section tends to diminish upward, or away from the evident source. Moreover, he shows that the ore of each such chimney may have a constant and individual composition different from adjacent chimneys, which have each their own individuality.

In correspondence with me, Mr. Prescott has stated his belief that such adjacent and individual chimneys have been introduced (I shall say "injected") at different times and indeed in some cases, at least, with long intervals of intervening time. He writes to me (and I take the responsibility for putting his thought into print): "I describe to my staff the occurrences as a series of squirts, each taking a short time, but extending over a long period and separated by intervals of quiescence. . . . In form, condition, and general appearance I will admit that the orebodies more closely resemble certain igneous intrusions which I have seen than any deposits formed by secondary action, the only solution effects with which I am familiar. I cannot, however, account as yet for the limestone which formerly occupied the space now occupied by the ore, nor for the lack of any concrete evidence of the passage of the mineralizer through the underlying shales and sandstones of this province. You will note that in this letter and in the article I have carefully refrained from using the word 'solution' or the word 'injection,' but have confined myself to the term 'mineralizer,' be that mineralizer what it may. That it is thicker and more viscous than was admitted under the old ideas is quite evident; but I believe we have a step or two yet to make before we reach a completely acceptable hypothesis."

Indeed, I feel that I can add little to these preliminary

[2] "The Ore Magmas," Vol. II, pp. 875-876, Figs. 169, 170.

[3] "The Ore Magmas," Vol. II, p. 782-784.

[4] J. E. Spurr, *Engineering and Mining Journal-Press*, Vol. 117, No. 6, Feb. 16, 1924, p. 287.

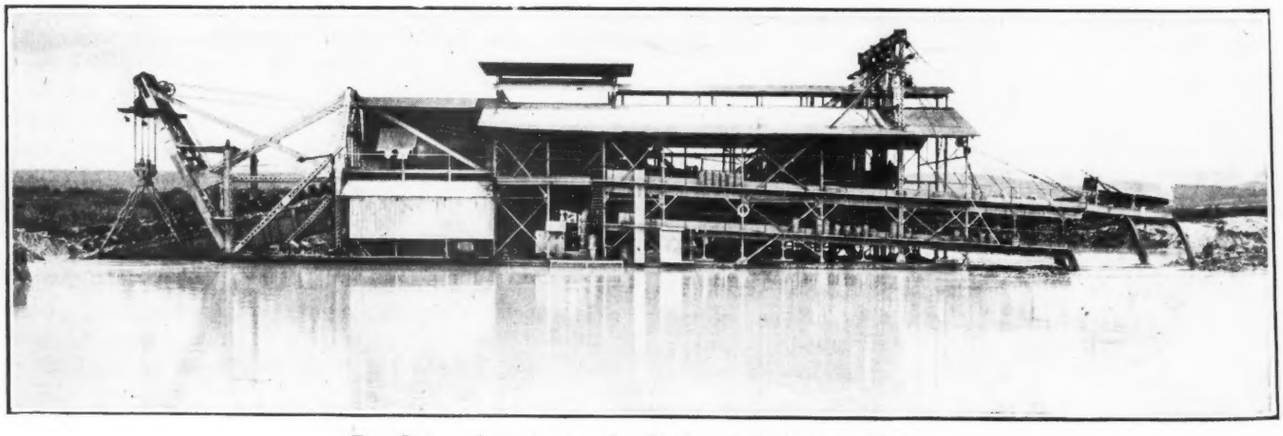
hypotheses, but must concur in them as well as with the implied reservation. It is becoming increasingly evident that ore magmas can ascend along fissures or through unfavorable beds to find a favorable locus of consolidation, without necessarily leaving a marked or definite downward connection of such consolidated material. Orebodies represent the ore magma as crystallized—where it did not crystallize it seems to have in many cases ascended along narrow fissures, feeding into a reservoir above, as a small stream feeds into and fills a lake, or a small vertical dike into an overlying laccolithic reservoir. With loss of gaseous tension, closing in of the walls seems in many cases to have nearly obliterated the traces of the original conduit beneath.

For lead-zinc ore magmas it is indubitable that they are especially consolidated by chemical reactions with limestones, and that the solutions or magmas may pass through underlying siliceous rocks, leaving relatively insignificant traces in the form of final consolidation.

The descriptions and conceptions put forth by Mr. Prescott definitely imply that each ore-magma column worked its way upward much as a worm works through wood: that at the upper tip of each fluid column the limestone was removed, creating a hole into which the sulphide magma followed. The ore itself in general was not therefore mainly deposited by replacement, but by mainly infilling a cavity so created. These are conceptions which I had not applied to such ore deposits in my analysis of such occurrences, in "The Ore Magmas." As to the nature of this cutting tip of the ore-magma column, the cases I have cited of ore chimneys in igneous rocks indicate that it consists of volatile elements or compounds; and since, in these ores in limestone, broken fragments of the wall rock are not characteristic, and especially by the evidence of the very preference of these ores for limestone wall, it is proven that such a gaseous tip or upper cushion had power to eat away and dissolve limestone. Speculation as to the nature of such solvents naturally ensues. In view of the great solubility of limestone in certain acids, especially hydrochloric acid, it is easy to suspect that the solutions in question were of that nature; but the evidence of the siliceous-alkaline, or calcic-alkaline, nature of ore magmas in general is so universal that this plausible explanation is rejected. Moreover, there is no evidence of acid reaction on siliceous-alkaline wall rocks or included fragments, in the case of the ore chimneys in igneous rocks above described. It is indeed most likely that such acids are mainly formed by chemical reactions in the superficial zone; and that they form no part of the plutonic ore magmas like those under consideration. The action of substances like sulphuric acid and fluorine, which by reaction with limestone form relatively stable compounds, is likewise apparently excluded. Indeed, the fact that these mordant solutions attack siliceous and alkaline rocks very slightly indicates that they may have been siliceous-alkaline or alkaline. Carbon dioxide, under pressure, dissolves limestone freely, and thus has been suggested to me in such a connection as this by Mr. Horace E. Freeman.

It is to be noted that all the cases described by Mr. Prescott fulfill the typical conditions for an ore-magmatic province, as I have defined them many times[5]: 1. Domical uplift (due to igneous surgence in depth). 2. Pre-mineral faulting, usually slight. 3. Ore injection. 4. Post-mineral faulting—after mineralization. Actual igneous dike injection may take place after the doming and before the ore injection, as at Aspen, in Colorado, and in the Kentucky-Illinois district; entirely after the ore injection, as at Santa Eulalia; or both before and after the ore injection, as at Mapimi (Ojuela); or not at all. These various periods of dike injection have little significance: the history of domical uplift, slight pre-mineral and stronger post-mineral faulting, and ore injection, have more significance and diagnostic value as to the nature of an ore-magmatic province, and the nature of an ore-magma as a definitely timed injection in a series of magmatic processes consequent upon upward magma migration. Lead-zinc deposits of this nature, by reason of their relatively high position in the ideal zoning of metals (according to the Zonal Theory), and their consequent relatively moderate temperature, are typically at a considerable distance above the magmatic hearth whence the lead-zinc magma sprung: hence they may and do occur without the close association of igneous rock intrusions, a lack of association which does not cast doubt upon their magmatic character—for once understood they constitute in themselves a magmatic and igneous type.

[5]J. E. Spurr: *Economic Geology*, Vol. XV, No. 7, 1916, p. 601. "The Ore Magmas," Vol. I, p. 334.



Dredging for tin in the Federated Malay States

The operation is on a property controlled by the Yukon Gold Co.

Useful Operating Ideas

Driving Timbered Raises at Butte

By Clarence M. Harrer

Overhead stoping with square-set timbering and waste filling is the general method of mining employed in the Butte district. Levels are driven in 100- to 200-ft. lifts and roomy stations are provided. Single- and double-track sill drifts vary in size.

Raises are generally classed as six- and eight-post raises or two- and three-compartment, respectively. The six-post type is three posts long and two wide, providing for a chute and manway. It is often driven more than two posts wide to facilitate breaking. The eight-post type is driven four posts long and two or more posts wide, for the same reason. It provides for a manway and two chutes, one on each side of the manway. The latter type is the most common. Raises are also classified with reference to their position in the vein as either foot-wall or hanging-wall raises. Figs. 1*A* and 1*B* represent the arrangement of an eight-post raise.

Raise timbers are standard square sets and auxiliary members such as have been found most suitable in this district. In some of the mines round timbers are used and in others squared timbers. Caps are slabbed on one side for flooring. Chute mouth members, lagging, grizzlies, specials, sometimes the angle braces, chute braces, and blocks are usually the only squared timbers used outside of shaft work. The timber is principally tamarack, pine, or fir, depending upon which is available on the forest reserve. Practically all the mine timber comes from Montana holdings, and is framed at Rocker and Bonner. Small mines have their own sawmill; larger ones have a plant to frame special timbers.

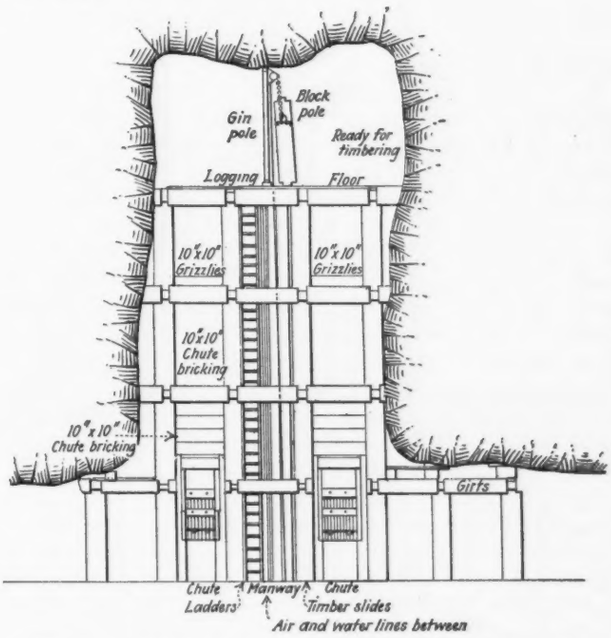


Fig. 1B—Sketch of eight-post timbered raise in longitudinal or girtwise section

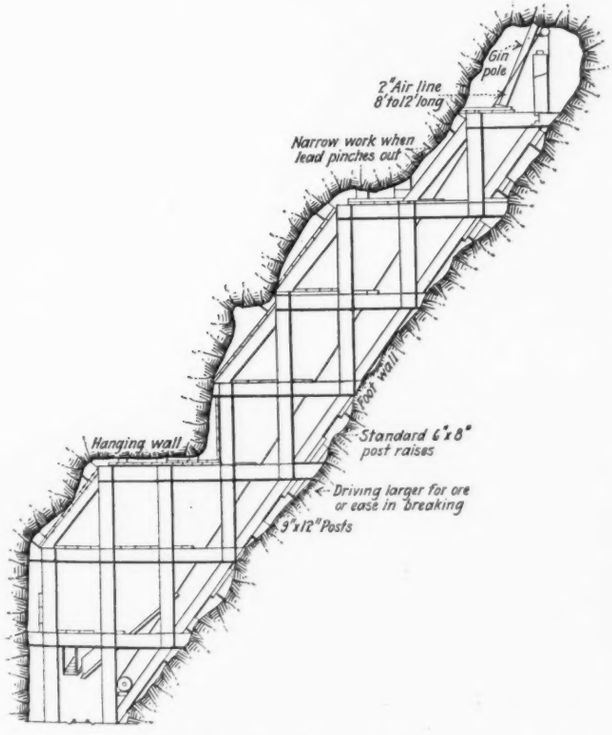


Fig. 1A—Sketch of eight-post timbered raise in transverse or capwise section

Standard square-set posts are 7 ft. 5 in. by from 8 to 20 in. in diameter; caps and girts 5 ft. 4 in.; sill posts 7 ft. 10 in. In pitching chutes all sides may be lined but usual practice is to line only manway sides; in vertical raises all sides are generally lined.

First Floor in Raise Most Difficult

The most difficult part of raising is the starting of the first floor. Several conditions must be considered. Traffic on the sill floor must not be hindered. This requires that especial care be taken not to break the floors or sill timbers, thus choking up the haulageway and breaking the main air and water lines which supply the rest of the level. These difficulties are readily understood by men who have worked in hard ground that requires heavy blasting. In ground where the back "rides" on the sill timbers the work is especially difficult. The usual procedure is to blast light rounds until a working opening is cut above the timbers. Once a three- to five-foot opening is made, a complete round can be drilled and blasted. Where the back cannot be drilled from the sill, stagings are erected by the miners. Two-inch lagging is spiked between the posts, and floors of standard lagging are placed on these. Miners drill

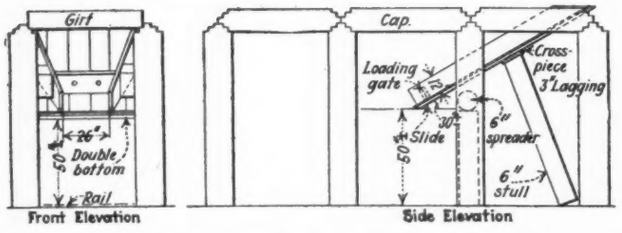


Fig. 2—Construction of slide used as a temporary structure to facilitate loading out broken rock. Angle of slide, 30 deg. Chute lagging 2 in. thick by 7 ft. 10 in. long

from this position, using hand-rotated water stopers.

On completing the drilling of the first light round, temporary slides (Fig. 2) are put in each of the raise sets to draw out the muck. If the back lagging boards cannot be pulled, they are blasted out. After loading the holes the sill caps and floors around the raise sets are reinforced by stulls and headboards. The round is then blasted. This is almost invariably done at lunch time or when the men go off shift. After the gases have cleared away, the miners load from the slides, or help the loaders and do odd jobs necessary after the blast. When enough muck is pulled to allow the miners to crawl into the opening through the slide (chute), or over the timbers, they go in to bar and clean down. If the back is low, the slides must be ripped out, stagings built, and a new round drilled. The slides are replaced after the holes are loaded. After spitting, the miners get out through the slides. When the rock is cleaned out, there is generally enough room to lay floors, capwise, and drill from them. In case there is not enough room, the last procedure is repeated. A full-sized round is now put in, generally from 5 to 7 ft. deep, depending upon the lengths of steel obtainable. This varies from time to time. After drilling, all the tools are taken down and away from the blast. The round is then blasted into the slides. This should make more than enough room for placing timbers.

After barring and cleaning down, the miners prepare for timbering by ripping out one slide (the central one in the eight-post raise). They then rustle timber on the sill floor and boost the timbers to the floor above by hand. After the mortises are cleaned the posts are erected and sometimes laced together with 2-in. lagging, and top blocked. For the full sets the standard square-set timber is used. In offsetting, the foot wall and the hanging wall are timbered with angle braces and standard caps and girts (Fig. 1*A*). If joints are good, no blocking need be done until all of the timber has been erected. The posts are stood with the big end up to steady the caps and girts. Bottoms are steadied by wedges or chips around the tenon. The ends are blocked loosely for alignment, and after that the sides.

When the timbers are approximately vertical, the butt-blocks are wedged as tight as possible. In raising, miners use the largest timber they can handle conveniently, as this procedure almost entirely avoids lost time in replacing broken timber. Preparation for drilling is then made by building stagings and boosting up the tools.

MANWAYS ARE DOUBLE LAGGED

In the Butte district the ground varies from very hard, tough rock and ore to loose fitchery ore and even to a clay or mud. After drilling, two 10 by 10-in. by 6-ft. grizzly timbers are put across each chute, capwise, 10-in. blocks being placed between the grizzly timbers. These are blocked into place, or if there is not enough room above the timbers they are omitted and a few lagging boards placed over the caps to break the fall of the rock to the slides below. The manway set is double-lagged and spiked in the eight-post raise and in the six-post raise, or a slide is put in the set used as a manway. The holes are then loaded, the staging and tools removed, and the air hose fixed in a protected position so that they will blow toward the back. The miners then spit their round and make their exit through the slides to the sill below. They generally wait near by to check their shots. The round may break high enough for timber if long steel is available, or another round may have to be put in. Five feet is the average footage obtained per round. After enough muck has been drawn, the miners enter the raise to bar down and to lay floors. All the muck is then drawn and the manway set opened up. The miners then prepare either to timber or to drill. If there is enough room for timber, they rustle and boost it up. The next floor is then timbered as previously described. When the second floor is timbered the standard chute mouth can be constructed and the first set lined. Chute members are specials which are cut to a standard design

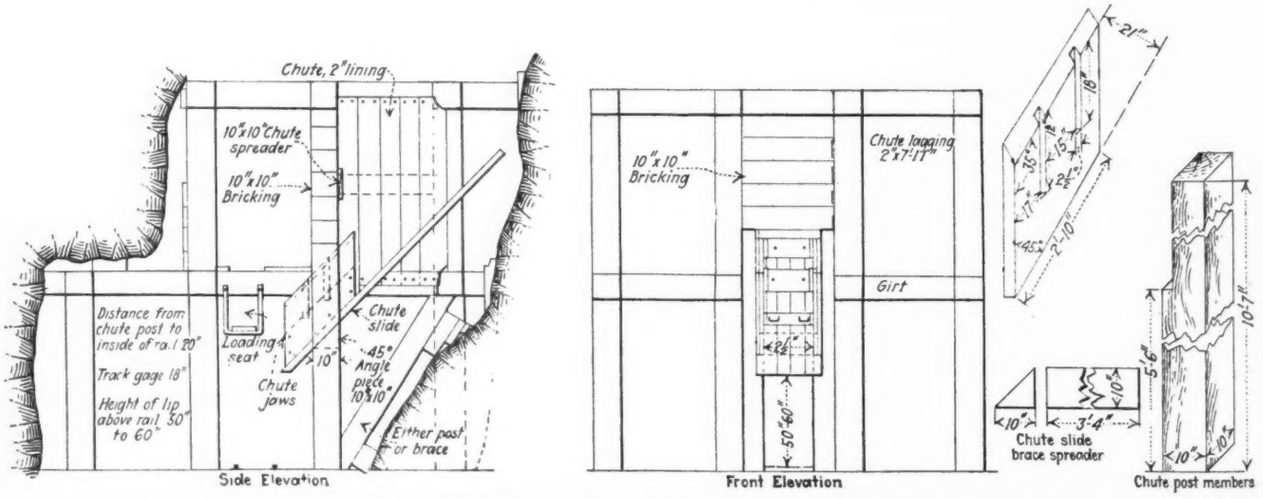


Fig. 3—Construction of chute mouth, showing side view, front view and details

and are easy to put together. The most generally used chute mouth is shown in Fig. 3. Some other mines use the "Arizona chute," introduced by the Clark interests from the United Verde properties in Arizona.

After the chute mouth is in place and the first set lined up, drilling and blasting is again resumed for the next floor. Before blasting, the chutes are lined and the grizzlies placed in the first or second set. Several variations are encountered. In raises following a pitching vein the square sets and foot wall are lined, and the hanging-wall sets are left open to allow for an entrance. In six-post raises the three sides of the chute are lined and a slide is put in the manway set. The slide can then be opened from the manway to enter the raise after the blast. Some miners line the chute sides in the regular way, leaving the manway sides open. They then line the manway sides, post to post, with standard three-inch lagging, bracing the boards with a stull and a piece of cross lagging which bears against all of the lagging boards on the side (Fig. 4 *E*). They enter, the stull is knocked out and the lagging removed when necessary.

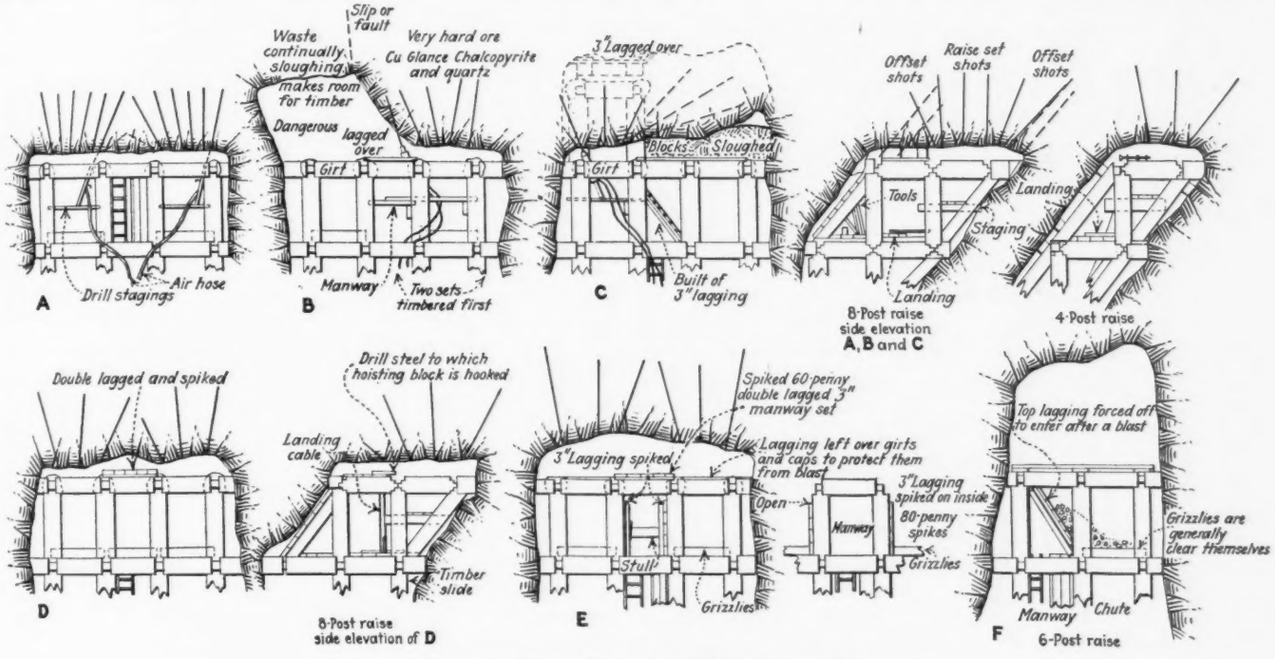


Fig. 4—Examples of drill hole rounds

A, Round used in very hard ore which might require the use of a mounted drill; 48 holes more or less are required for an eight-post raise; in drilling for offsets up to 72 holes may be required; in medium hard ground 36 holes may be required. *B*, Change in round due to variation in hardness of rock; 20 holes may be required for an eight-post raise and 15 holes in medium hard ground; 10 holes or less may be required in weak fitchery ground. *C*, When raising in soft or loose sloughing ground, a lead set is extended on the hardest side. This is timbered and the remaining ground stoped out. A slide is built across the manway set. In some instances the back lagging may have to be blasted out. *D*, Average round in waste; no set rules apply, the miner's experience being his only guide. *E*, Sketch showing the lining of chutes before a blast; two methods are shown. *F*, Longitudinal section six-post raise showing slide and grizzly immediately above the chute and manway.

No Standard Methods in Raising

There are no standard methods in raising. The actual work is left to the miners. When the chutes are lined, with the exception of two lagging boards to allow the men to get out, the miners spit their round and close the opening. They then leave. After the blast they free the chutes and clean down. This may take a few hours to several shifts, depending on how soon the muck is removed and on general working conditions. From this time, as in the preceding instance, either timbering or drilling is done as needed. The second set is then lined completely and the third timbered. The grizzlies are moved up a set. Various arrangements of rounds are shown in Fig. 4.

In some of the mines the chute sets are entirely inclosed, whereas in others only the manway sides are lined. In the former case 4-ft. 6-in. chute braces are put in, one on each side and two generally on the manway side. The sides are then lined with 2-in. by 9-ft. 6½-in. chute lagging of varying widths spiked with 40-penny nails. In certain mines squared braces are used and in others rough unpeeled timber. Ladders, timber slide, and landings are put in. The ladders are ready to put in and are held to the timber by 80-penny spikes or heavy iron staples. Ladder sides are 2 by 4 in. by 9 ft.; rungs 2 by 1¼ in. by 14 in., sunk into sides ¾ in. at 12-in. centers, eight rungs to the ladder.

Ladders are placed at the extreme left of the manway; the timber slide is at the right and the air and water pipes are between. Slides are spiked girt to girt, two 2 by 12-in. by 9-ft. slide lagging being used in the offsets and two standard chute lagging 12 in. wide in straight lifts, the sides being 10- or 12-in. lagging. The inside width of the timber slide is 20 in.

Utility the Important Consideration

Landings are made as simple as possible, and are not kept clean or built for maximum safety. Utility is the important consideration. Most of the raises are driven three or more posts wide, generally a complete set and an angle set on the foot wall, with probably a hanging-wall set. In this instance the complete set is partially covered over with standard lagging, cap to cap, leaving an ample opening for the ladderway and enough room to hoist timber up the slide. A standard piece of lagging is then laid girtwise to serve for a footing. Landings vary, however, in the different mines and even

in the same raise, depending upon the taste of the timbermen.

For the first two or more floors, air hose are used for ventilation; later, small blowers are installed at the foot of the raises on rough platforms, or, if the sill is especially hot, as is often the case, the blowers are set in a cooler place. Ventilating pipe, 8 to 14 in. in diameter, is used to carry the air up into the raises. Small air hoists with light steel cables or rope are installed for hoisting. The cable runs over a steel block hooked over a drill steel or on the end of a 10-ft. gin pole made of a length of compressed-air pipe. The cable is generally provided with a length of chain and sometimes a safety dog is attached to it.

Offsets Necessary in Inclined Veins

In driving succeeding floors, the work is more or less routine; however, if the raise follows the walls of the vein a great deal of offsetting is necessary. This may lead to one or more sill sets of either "bald-headed" posts or to cap-silling. Probably angle sets may suffice. The general rule is to strip the wall which is followed. In the same mine and even in the same raise the ground may vary greatly, ranging from very hard ore and country rock to mud or crumbled, fitchery ground very difficult to drill, and dangerous. The presence of very heavy ground and copper-bearing water is a drawback, as the latter causes sores and annoyance to workmen through chafing and getting into the eyes.

In the case of the 100-ft. level interval, twelve floors will sometimes complete a raise. In most instances "pup-sets" or cribbing are necessary to catch up the sill above. In hard, firm ground "holing through" entails no trouble to the miners. However, in many of the mines in Butte the sill above has working gobs, heavy ground, or loose, shifting ore, which has to be opened very cautiously to prevent caving the sill and timbers. Although most raises are holed successfully, there have been very bad messes, exceedingly difficult and hazardous to catch up. In some, the upper sets have had to be bulkheaded.

Stull-Timbered Raises Also Used

In addition to square-set raises, stull-timbered raises are also occasionally driven. As the larger veins are worked out the companies are paying more attention to the smaller ones. These are generally mined by rill-stoping. Raises are driven on the incline similar to drifting, and are stull-timbered. In this type the manway sides are the only sides of the chute lined. The raise is placed with reference to its usefulness. When a suitable place has been determined the sill sets are marked. Later the raise is located on the maps. When the raise approaches the sill floor above, the place it is supposed to hole through is determined by co-ordinates. This point is also readily spotted by sound and dust clouds as the raise approaches the sill. The section of the sill floor involved is then reinforced by blocking, stringers, and stulls. As the raise is advanced it is recorded by sketches of the respective floors in plan and cross-section. The timbering is assumed to be vertical and gives the line of the raise. In stulled raises the line is kept by sighting along the timbers. No instrument work is necessary unless connections are made between a winze and a raise.

Barring down, in most raises, is an arduous and risky task. After the blast, if slides are in, the miners find a place which offers the easiest access to the working opening. In sloughing ground, the firmest corner can generally be determined by sound. This does not always govern the point at which an entrance is made, for the quickness and ease with which an entrance or exit can be made is fully as important, if not more so. After the slides are drawn, one miner climbs up through the slide or over the outside of the timber, if there is an opening, and quickly inspects the back. If it appears safe he signals his partner, who passes up a pinch bar and a pick. The partner then crawls up. Miners start barring down from the firmest corner; one holding the carbide lamps while the other handles the bar. When the latter tires they change over. All visibly loose slabs are pried loose. Sounding is then resorted to. By hitting the rock with the end of the bar, loose ground is detected by a hollow, drummy sound. This is not always the case, however. In very hard ore which breaks in fairly large blocks the metallic clang given off is deceptive. At times I have pried a long time at a mass of rock which, although sounding solid, was cracked. I couldn't budge it. Then a careless tap at a small inconspicuous key-piece loosened a large mass, which crashed down, breaking timber and nearly crushing my partner and myself. Barring down is a matter of judgment—and of luck.

In eight-post raises the miners enter through the hanging-wall offsets, over the grizzlies to the top of the manway set, which is double lagged and covered with muck. They then choose a solid spot to stand under, get a firm footing, and start in as previously described. In six-post raises, the top lagging boards of the slide over the manway set are knocked out. The miners then crawl up through this opening, sometimes closing it behind them, and start in as previously described.

When drilling, loose ground overhead can be detected by placing one hand against the back. Excessive vibration of the rock warns one that the ground is loose and should be barred down. A more impressive warning is the falling of small fragments or lumps which work loose from the back and hanging wall. Hanging walls should always receive careful attention, as they are especially subject to slabbing, more so if they are broken into. Pinch bars are generally from 6 to 10 ft. long, of round or octagonal steel, ¾ in. in diameter.

The ground in the Butte district varies from firm rock requiring very little barring to that which is always working loose in large blocks and slabs or just crumbled rock and clayey masses. In the latter case the miners have to take chances, with one eye on the back. They try to make the place a little safe, if they can. These places cannot, however, be made really safe, and worked. If the back is exceedingly high and is working, stulls and head boards are sometimes put in for auxiliary support. These are always in the way in such restricted openings as raises and are only a last resort.

Labor performance varies within such wide limits that no general statement can be made. Hardness, fitchery ground, danger of caving, loose ground, insufficient supply of drill steel, lack of timber on the level (timber is generally lowered on Sunday), and replacing broken timber are factors that vary and influence the rate attained. Abnormally high working temperatures of some places compared to others, differences in physical endurance and temperament of the various miners, their degree of skill, and their ingenuity also play a part.

Discussion

Geologic Features of Bolivian Tin-Bearing Veins

THE EDITOR:

Sir—I have read Mr. Koeberlin's article in your issue of April 17 on the above subject with much interest. My experience with tin lodes has been confined to Australia and Tasmania, but within those limits is fairly extensive. In so many cases, however, payable ore in outcrops and shallow ground is followed by low-grade ore, that unless secondary enrichment by solution and redeposition is admitted we must look for some more unorthodox explanation.

In certain cases, as Mr. Koeberlin points out, pyritic lodes from which the sulphur has been removed are much richer per ton of ore than the unaltered portion of the lode, for it may be that 30 per cent (I have known in one case over 40 per cent) of the gangue has thus been removed and the ore concentrated to that extent. But there are cases that require further explanation. In a great number of these the outcrops and shallow portions of lodes are not only much richer in proportion to the deeper portions than the oxidation of pyritic outcrops would indicate, but in some of them pyrite has never been present or has been present only in limited amounts. Rarely has copper been present, even in minute quantities. It is doubtful, also, that the result was due to the concentration of residual cassiterite after degradation of the outcrop. On the other hand I know of gossan outcrops practically barren themselves, while beneath them, in oxidized ore, much tin was found.

Tin behaves, however, in many mysterious ways. Many years ago I noted that in Cornwall 15 per cent of the tin recovered was saved by the tin streamers from battery tailings. The Cornish operators had hundreds of years' experience in the treatment of battery tin, and it is probable that their methods, though we now despise them, were more efficient than we would care to admit. In fact, in one case within my knowledge where the old methods were abondoned and an "up-to-date" plant was erected, the saving in fine tin fell off considerably. At any rate, when their treatment was finished one would not expect streamers, with their crude methods, to save any appreciable amount of the tin left. Did the cassiterite undergo any change in its character on its exposure to air and water? Was there anything like the action that has been claimed for the formation of gold nuggets? (This theory, of course, has been ably rejected by some authorities). Or was there anything like the regelation of ice?

Many of us still adhere to the vanning shovel as a test of tin ore in preference to the wet methods of assaying. We hold that it is more useful to know how much tin we shall be able to save than to know of the existence of tin that no known methods will satisfactorily separate from the gangue. In a number of cases, however, I have used both methods, and while there is no appreciable discrepancy between them for comparatively rich ores, wet methods give results perhaps three or four times as great as vanning would do in poor ores. In some cases quite appreciable values of tin were recorded when no trace of tin could be seen on the vanning shovel. This is after adopting all the precautions any competent critic would suggest. Is it tin that gives these results? Or is it tin in some invisible form? Does the tin exist in a colloidal state? I have seen in settlers after a roasting furnace tin deposited in an impalpably fine state, practically a jelly.

Some of the Chinese alluvial workers claim that tin grows. Ground that has been too poor to work has been left for two or three years, and then again worked with satisfactory results (at least, so they say), and they claim that in the meantime the tin has grown. In sampling old alluvial mines where a face is exposed I have always cut a chase deep enough to get into solid ground, as I have found the surface enriched, doubtless by the water running over the face carrying away the lighter gangue. That may be what led the Chinamen to their conclusion. I hardly think that the result has been due, as has been suggested, to a process similar to the production of lead from the degradation of radium and that some element was undergoing a similar change into cassiterite.

Have I not read that some one has found that cassiterite is slightly soluble in sulphuric acid? If so, that would explain secondary enrichment in a number of cases.

Stannite is not found in any of the lodes worked for tin alone in Australia, though large deposits are known in Leehan (Oonah Mine), Tasmania, and at Howel and Tolway, New South Wales. At Leehan it is associated with pyrite and chalcopyrite and small percentages of bismuth and antimony sulphides and sometimes with galena. At Howel it is associated with galena, zinc blende, and mispickel; at Tolway with mispickel, chalcopyrite, galena, and zinc blende. No successful metallurgical process has been evolved for treating any of these ores, and these mines are now closed down. Usually the cassiterite of the tin lodes of Australia and Tasmania is very free from impurity, and a concentrate of 72 per cent is not unusual. JAMES B. LEWIS.

East Malvern, Victoria, Australia.

All Greek

THE EDITOR:

Sir—You may discontinue my subscription to the *Engineering and Mining Journal*, for the reason that I don't like the stand you take in regard to people who are trying to open the country up, for instance C. C. Julian or anyone else who has guts and money enough to take a chance. If no one did any digging or put up money to have it done, there would be very little ore opened up. I think if one venture out of a hundred makes good, the country and people in it are benefited by effort. What we want is to have the blue-sky law

of this state repealed and money and people with guts enough to dig. The mining engineer is afraid to pass favorably on a prospect, and I think a man is a fool to pay any attention to them. They can't see into the ground, and they don't know until the property is proved up by digging where they are at any more than I do, and the terms you use in describing a country outcrop and the different rocks is all Greek to me and to thousands of others. You spread the salve for the smelter and try to make the producer satisfied. No, I don't want your journal. LOUIS KEIPER.

Cima, Calif.

Cutting With Oxy-Illuminating Gas

THE EDITOR:

Sir—I believe that the caption underlining the picture on the front cover of the *Engineering and Mining Journal* for July 17, 1926, stating "The oxy-illuminating gas torch is a new development in shop work. The one seen here is removing a 15-in. riser more cheaply than it could be done with hydrogen or acetylene," is by no means an accurate statement of the facts. For your information, the situation is more nearly as follows:

The cutting blowpipe for the use of illuminating gas, natural gas, city gas, and various other kinds of manufactured gas with oxygen is not new. Much attention has been given to the development of a torch for this purpose, and a considerable number of them are in operation at certain localities where a number of surrounding circumstances continue to make their use possible. It may also be said that the idea of using preheated gases was tried a number of years ago, but the results at that time did not warrant its commercial development.

Most flame-cutting is done today by an oxy-acetylene torch using a large excess of oxygen. Many efforts have been made to substitute a cheaper fuel gas for the acetylene, and several such gases are being vigorously exploited.

Theoretically, it should be possible to cut hot steel with a stream of pure oxygen alone; in other words, once a spot on the steel has been heated to the kindling temperature, the heat generated by the iron burning in the oxygen should thereafter be sufficient to keep the flame burning. This statement of the theoretical aspects of the case brings prominently forward the practical limitations.

In the first place, the steel must be raised to the kindling temperature, and, other things being equal, the time required to do this is shorter as the flame temperature goes higher and higher. Since the oxy-acetylene flame produces a much higher temperature than the various substitutes can produce, it requires much less time to bring the initial spot of cold steel to the kindling temperature than when using the oxygen and city-gas flame. During this preheating period, of course, labor charges go on. It therefore results that the expected saving to be made by using cheap fuel gas does not materialize, because of the labor costs accruing while waiting for the cut to get started. Unproductive labor charges are of course easiest to observe and assume a prohibitive size when making short-cuts or when cutting off rivet heads with oxygen and city gas.

In commercial apparatus the fuel-gas flame is not turned off after the cut is started, because it is found that this is needed to overcome the slight irregularities contained in the steel. A little piece of rust on the surface of the steel would also snuff out the flame unless a sizable preheating flame is always present. Auxiliary heat is required in greater and greater measure as steel contains more and more dirt, either on the surface or in the body of the steel itself, or as the carbon and alloying elements go up. For that reason the oxy-illuminating gas flame gets into trouble quickly with dirty metal, high-carbon steel, and high-alloy steel, and is utterly incapable of doing anything with cast iron. For all of these substances the more intense heat of the oxy-acetylene flame is needed.

All of the above is based on the assumption that the illuminating gas available is of very high quality. (As a matter of fact, I imagine that most of the readers of *Engineering and Mining Journal* who are interested in oxy-acetylene cutting live in locations where city gas of any kind is unobtainable.) In practice it is found that many gases are unsuitable for cutting of any sort unless they are enriched with heavier hydrocarbon vapors or unless they are compressed to a considerable extent. The cost of this enrichment and compression of course helps to cut down the theoretical but illusory profit from using gas costing much less than acetylene per cubic foot. E. E. THUM,

New York, N. Y. Oxweld Acetylene Co.

Iron in Venezuela

THE EDITOR:

Sir—In an article by Olin R. Kuhn published on page 84 of your issue of July 17, 1926, concerning the world's iron-ore resources, I notice that no mention is made of the large iron-ore deposits in Colombia, in contrast to the much smaller deposits in Venezuela. In the vicinity of Zipaquirá, Department of Boyocá, there are extensive deposits of hematite. The principal exposure is that of La Caldera, of which a fair estimate of net metric tons is 38,345,000. An average of several samples taken in connection with the late William Francis Wilson two years ago was as follows: Fe, 74.57 per cent[1]; SiO_2, 6.38; Al, 1.80; Mn, 1.35; CaO, 0.30; P, 0.032; S, 0.038; CO_2, 4.32; and moisture, 1.21.

Within a kilometer or two of the Caldera deposit there is a considerable area of early Cretaceous or Eocene coal measures, of which 29.5 ft. of workable beds is exposed. An analysis of several samples taken from below the outcrop gave: Volatile, 37.16 per cent; fixed carbon, 58.18; ash, 4.30; sulphur, 0.36; and moisture, 1.10.

There is also in the same vicinity a large area of Cretaceous limestone of which the following is an analysis: $CaCO_3$, 95.37 per cent; $MgCO_3$, 1.47; SiO_2, 0.88; Al_2O_3, 0.48; Fe_2O_3, 0.40; and water, 1.40.

These deposits are all on the line of the railway from Bogotá to Barranquilla that was promoted by ex-Senator Lorimer, of Illinois, and which was never constructed, for reasons not necessary to enter into here, under the name of the Sindicato Colombo-Americano. Examination of these deposits was made also by Messrs. William Jones and P. A. Alig for the syndicate.

The time may possibly come when pig iron from these deposits will find its way down the Magdalena River to the markets of the world.

Fort Sumner, N. Mex. H. F. COLLETT.

[1]Seems high.—THE EDITOR.

News of the Week

The Mining News given in ENGINEERING AND MINING JOURNAL is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary

UTAH Copper replaces steam shovels with electric shovels—Mines at Bingham, Park City, and Tintic operating at full capacity.

Hollinger enlarges operations; dividends to date $35,000,000; large reserve assured—Dome production decreasing—Rouyn railway work rushed.

Commerce Mining installs Diesel engines—Quincy equips plant with new boilers—Arcadian prepares Baltic shaft for operation.

Ore hauling in Joplin-Miami district an important independent business with large capital outlay.

Regular copper shipments from Arizona via Panama Canal—Revival of placer mining in Arizona.

Depreciated franc felt by London mining shares; much interest in tin as price rises—Indian Currency Commission recommends gold-bullion standard.

Tasmania reorganizes Department of Mines; Hampden-Cloncurry mines for sale—Zinc-lead deposits in Finland under development.

Expansion of Mines Bureau depends upon Budget Director; personnel under the new plan of organization; the title "Engineer" recognized.

Grasselli Chemical acquires pyrite mine in Algoma district, Ontario. Consolidated Mining seeks phosphate deposits.

Tonopah maintains steady production.

Star Mine (Burke, Ida.) Develops Large Zinc-Lead-Silver Orebody

The Star mine, in the Coeur d'Alene district, Idaho, owned jointly by the Bunker Hill & Sullivan and the Hecla mining companies, is now producing at the rate of 450 to 500 tons or ore per day, which is practically the present capacity of the mill. The ore is zinc and lead-silver, the first being the chief product and for the treatment of which the electrolytic plant is now being built at Kellogg by the Sullivan Mining Co.

Development of the Star is proceeding in reverse order to that usually adopted in mining operations, starting from the bottom instead of the top. The original work on the property consisted of the usual tunnels high up on the mountain, and the oreshoot exposed was further proved in later years by exploratory work from the workings of the Morning mine. This work having proved quite a large tonnage, when the Bunker Hill & Sullivan and Hecla came into possession of the property they organized the Sullivan Mining Co. and proceeded to drive the Star crosscut, almost two miles long, from the 2,000 level of the Hecla to provide a permanent operating outlet for the Star. This cut the vein over 4,000 ft. beneath its apex and a drift extended east some 1,600 ft. made connection with the workings of the Morning mine. Development of the ore above this level is proceeding, three levels having been opened, known as the 3,700, 3,500 and 3,300, corresponding in elevation with the levels of the Morning mine with which they will connect. In the meantime a vertical raise is being extended from a point well out into the footwall on the 4,000 level to connect with the old Star tunnel 2,800 ft. above, more than a fourth of which has now been accomplished. This when completed and connected with the various levels will be the Star operating shaft.

Copper Wire to Compete with Aluminum in Coolidge Dam Construction

A DISTINCT VICTORY for copper was recorded when copper wire was allowed to compete with aluminum in the construction and equipment of the Coolidge Dam, on the Gila River. The bids for the 80 miles of wiring closed on July 30, and through the efforts of Arizona's Industrial Congress petitions were wired to Charles Burke, Commissioner of Indian Affairs at Washington, protesting the specifications and requesting that copper wire be permitted to compete.

On July 29 word was received that government officials had rejected the original bids and that new specifications were drawn permitting copper wire to compete with aluminum.

Hawthorne Mills 60 Tons Daily

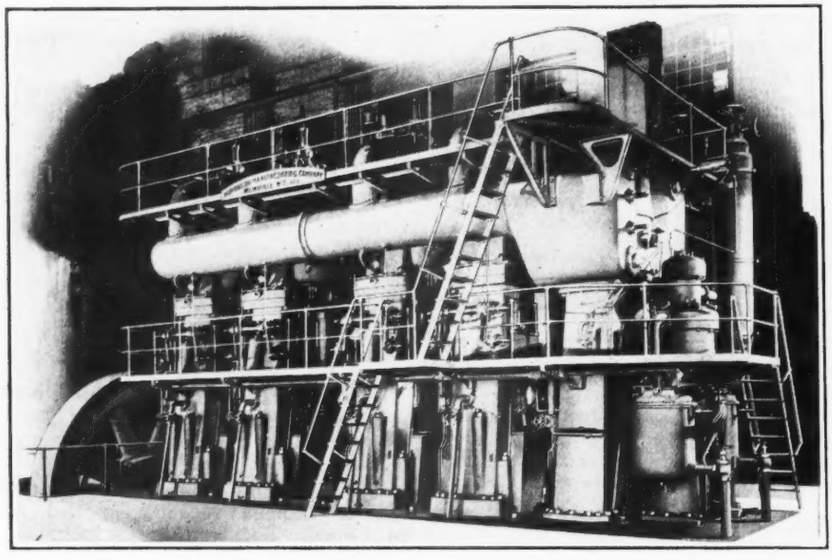
Conservation of water by damming the tailing discharge from the flotation mill and pumping the water back has enabled the Hawthorne Mines, Hawthorne, Nev., to continue milling 60 tons per day. A new shoot of high grade argentiferous galena has recently been opened in the footwall of the Mountain King vein.

Consolidated Mining Seeks Phosphate Deposits to Utilize Waste Sulphur

The Consolidated Mining & Smelting Co. of Canada recently applied for 91 more licenses to search for phosphate in the Fort Steele mining division of British Columbia. The company stated in its annual report that its object in finding a commercial deposit of phosphate of lime is to enable it to utilize the sulphur content of its Sullivan mine ore. As often has been stated, the Sullivan ore consists of an intimate mixture of sulphide minerals with from 3 to 6 per cent of earthy gangue. The mill tailing is largely composed of sulphides of iron and in a condition ideally suited for the manufacture of sulphuric acid. Given a use for the acid, such as would be found in the manufacture of superphosphates, it is believed that its manufacture at Trail would be an exceedingly profitable enterprise. But it is understood, though no official announcement has been made, the company's ambitions with regard to the Sullivan mill tailing do not end with the manufacture of superphosphate; it proposes to utilize the residual ferric oxide, or blue billy, from the roasting operation for the manufacture of high-grade alloy steels in electric furnaces. The company is searching for deposits of manganese and chrome ores, and recently its power subsidiary, the West Kootenay Power & Light Co., started on the preliminary work for the construction of another series of power units on Bonnington Falls, which, it is understood, will bring the total capacity of the three hydroelectric stations on the falls up to around 150,000 hp.

Commerce Mining Co. Installing Diesel Engines

The Commerce Mining & Royalty Co., of Miami, Okla., recently placed an order with the Nordberg Manufacturing Co., of Milwaukee, Wis., for three 2,250-h.p. Diesel engine units to be installed at Cardin, Okla. This company has fifteen mines and mills in operation and also owns the North East Oklahoma Railroad, which is operated by electricity. At present much of the power is generated by small steam- and gas-engine units situated at widely separated points. The major portion of the power, however, is purchased. It is planned to locate the Diesel plant at Cardin and run transmission lines to the various places where power is used.



Commerce Diesel installation for Cardin, Okla.

The longest line will be about 14 miles. This new Diesel plant will rank among the largest in North America, among which is the 9,400 h.p. plant of the Moctezuma Copper Co., at Nacozari, Mexico, and the 6,900 h.p. and the 6,250 h.p. installations of the Phelps Dodge Corporation, at Bisbee and Morenci, Ariz., respectively.

Zinc-Lead Deposits in Finland Being Developed

According to a report to the U. S. Department of Commerce, the mines of Orijarvi, Filnand, are beginning to produce anew, after a considerable period of inactivity. Having bought the mines and undertaken different experiments and preliminary work, production was begun by Orijarvi Gruvaktiebolag a few months ago. The intention is to extract the zinc and lead instead of copper, which was formerly extracted on this property.

In the Orijarvi ore there is reported about 790 grams of silver per ton of lead ore, and this metal is also extracted. The yearly production is calculated at about 4,000 tons of zinc concentrate and 500 tons of lead concentrate. The products are being sold to German metal firms, who pay according to London quotations. Initially the old ores on the surface will be exploited, and they suffice for a period of six years. At the same time a survey will be undertaken to find out the ore reserves in the mine.

Exports of Steel to Far East Show Decided Gain in Half Year

The U. S. Department of Commerce states that the exports of iron and steel products to the Far East for the January-June period of 1926 recorded gains over the corresponding period in 1925 to all countries except China, and even there the loss was infinitesimal. The port of Hongkong showed the effects of the Chinese boycott in that exports to it dropped considerably. The total to the Far East for the first six months this year was 233,399 gross tons, as compared to 133,531 tons for last year, a gain in tonnage of 99,868, representing a 75 per cent jump. But the first half of 1925 did not represent a normal year, as shipments to Japan were less than half of those in either 1923, 1924 or 1926, due chiefly to the fact that exchange was low, making the cost in yen in Japan of steel commodities anywhere from 10 to 20 per cent higher than normally, which tended to curtail sales. The shipments to the Far East in 1926 exceeded in tons those of any of the years mentioned above except 1924.

Arcadian Equips New Baltic Shaft

Arcadian Consolidated, operating near Houghton, Mich., is laying the foundations for hoist, compressor, and boilers at the New Baltic shaft, and removal of the surface plant from the New Arcadian shaft will soon be possible. This will save the cost of a new plant. Operations will be resumed in the New Baltic shaft and temporarily suspended in the New Arcadian until the corresponding openings in the New Baltic are extended. Drifting on the 1,250 level north from the New Arcadian is proceeding in ground, containing fair value.

Narrow Lake Gold Discovery Attracts Prospectors

Much interest centers in a new discovery of gold in the vicinity of Narrow Lake, some 30 to 35 miles northeast of Red Lake, in the district of Patricia, Ontario. The find is reported by Jack Lindsay, prospector, who has just come out from that district showing samples of free gold. The discovery was staked by Thomas Bathurst, of Ottawa, Ontario, and is about two and one-half miles northwest of the Duncan-McBain find, recently reported, and west of the Price-Logan find. News of the discovery has been followed by a rush of men from Hudson and Red Lake during the last few days. The Bathurst claims tie in the western part of the Price-Logan find, which was reported subsequent to the Duncan-McBain discovery. According to Mr. Lindsay, the vein is over 25 ft. in width and highly mineralized.

Quincy Installs New Boilers

The Quincy copper mine, Hancock, Mich., has ordered four 600-hp. boilers equipped with automatic stokers and superheaters. This installation will materially cut power costs. The new East vein in this property is rich both in copper and silver values at the 87th level of No. 2 shaft and is being consistently opened in conjunction with the usual work on the West vein. Quincy is in need of labor and is putting forth efforts to obtain it.

Consolidated Homestake Completes Mill

The Consolidated Homestake Mining & Development Co., Alice Arm, British Columbia, has completed the construction of mill, bins, and conveyor buildings and is now installing machinery therein. It is expected that the mill will be completed and in operation about the first of September.

The plant consists of a 120 hp. Diesel engine, a 15x9 in. jaw crusher, a 65-ft. 18-in. conveyor belt, 24x14 in. rolls, with Hardinge mills, Dorr classifier and 3 Wilfley tables.

Normal Conditions at Tonopah

July bullion production of Tonopah, Nev., was normal, and valued at approximately $193,000. The Tonopah Extension has recently opened some stoping ore on the 1,540 level west from the McCane shaft, in what has been designated as the Bermuda vein, and better-grade ore is being stoped from the 2,000 level west from the Victor shaft. Owing to these developments the company has been enabled to increase its bullion production, which for July was $54,000, although it is still operating at a heavy loss. Water-flow throughout various parts of the mine has decreased from a maximum of 2,100 gal. per minute to 1,500 gal. per minute.

The Tonopah Western is developing on the 1,100 level, to the east and north, to prove up the vein cut near the shaft on that level. Water-flow impedes progress but is not serious. At present this company is pumping about 650 gal. of water per minute.

Utah Metal Mining Generally Prosperous

Utah-Apex Adding 300-Ton Mill; Utah Copper Completes Electrification of Steam Shovels

METAL MINING in Utah is unusually prosperous, although there appears to be little stock speculation. The most significant new feature is activity in lead-zinc ores with accessory gold, silver, and, in some cases, copper, that were formerly either not mined or yielded only a small profit. The availability of two large custom concentrators, one at Midvale and the other at Tooele, provides an outlet for these ores, and at present about 1,650 tons per day from Utah, Nevada, Idaho, and Colorado is being treated at both plants and in the aggregate nearly 13,000 tons of zinc concentrates per month is being marketed. Selective flotation has made zinc a revenue producer instead of a penalty maker.

The increased ore tonnage means more miners, more supplies and power purchased, more freight, greater prosperity of the mining towns, more money to the companies, and increased dividends. Combination of mining properties into larger companies has also contributed a greater stabilizing influence to the mining situation. Although large company operation appears to be the important feature of Utah metal mining, leasing and small mine exploration appear also to have found encouragement.

Mines at Bingham

Utah-Apex is employing about 600 men and is adding a 300-ton unit to its mill in Can Fork Canyon. The new unit will treat a lead-copper ore assaying from 5 to 10 per cent lead and 2 to 5 per cent copper, containing very little zinc but up to 25 per cent in iron. A large orebody on the lower levels has been developed. It is expected that ores as low as 3 to 4 per cent lead and up to 2 or 3 per cent copper, gold 0.05 to 0.10 oz. and silver from 3 to 5 oz. per ton, can be handled profitably. The combined tonnage will be about 650 tons, of which 350 tons is lead-zinc ore now being treated. The present bottom level is the 2,400, and a winze is being sunk to the 3,000, the 2,600, and 2,800 levels to be opened out, and if the results of exploration warrant, connections will be made to the working shafts. Work is now being done through the Utah-Apex and the Utah-Delaware shafts, which are 2,500 ft. apart. The winze is being sunk midway between the shafts.

Milling operations have been standardized, and the present milling ore is being treated by selective flotation. A lead concentrate, 55 per cent lead or better and 5 per cent zinc, and a zinc concentrate 52 per cent zinc and 1½ per cent lead, are being produced, the zinc concentrate being shipped to Great Falls and the lead concentrate to Murray. Ores are crushed to from 5 to 10 per cent plus 80 mesh and 62 per cent minus 200 mesh. Concentration ratio is 6½ to 1 on lead and 8 to 1 on zinc.

The Utah-Delaware Mining Co., now controlled by the International Smelting Co., has taken over the development of the Utah Metal & Tunnel Co.'s property. It is mining from 500 to 600 tons per day, four types of ore making up this tonnage. The principal ore is lead-zinc of a grade containing 8 per cent lead, 7½ per cent zinc, 3 oz. silver, and 0.03 oz. gold per ton. In addition, a direct-smelting ore containing 20 per cent lead, ½ per cent copper, 4 oz. silver, and 0.08 oz. gold, a copper ore containing 4 per cent copper with accessory gold and silver, and a gold ore containing 0.4 oz. gold and 3 oz. silver per ton, with accessory copper, are being mined. The lowest working level is the 1,800. Ore is being mined from seventy-five different places in the mine and exploration is being extended. The new metallurgy of lead-zinc ores at the International custom concentrator has been a big factor in the recent success of the property.

The United States mine, at the head of Bingham Canyon, is sending about 400 tons per day to the Midvale concentrator. Many improvements have been made at this property during the last few years. A new hotel to accommodate 250 miners and a change house of modern construction have been erected. A 250-hp. Nordberg hoist was installed in the Niagara adit level and the shaft sunk from the Niagara tunnel to the Butterfield adit level, which adit has been connected with the shaft.

About 1,500 men are employed at the three mines named. Utah Copper has completed the electrification of all steam shovels and has installed a 60-ton Diesel electric locomotive. Additional waste disposal trackage is under construction. A production of about 35,000 tons per day is shipped to Magna and Arthur. The output per man-shift at the mine was increased to 19.89 tons in 1925, and this represents the result of large capital expenditures in improving the mechanical equipment. Both concentrating mills, at Arthur and at Magna, have also been greatly improved and are now on an all-flotation basis.

The weekly production of the Bingham district is 116 cars of ore and concentrates, or about 6,000 tons, which includes the U. S. Mine, credited with 61 cars; Utah-Apex, 34; Bingham mines, 12; Park Bingham, 6, and Chief Copper, 3 cars of copper precipitates. The foregoing does not include the Utah-Delaware production, which is about 500 tons of ore per day, nor the Utah Copper production, which is about 35,000 tons of ore per day.

Park City Mines

Mining operations at Park City are now concentrated in two important groups, the Park Utah Consolidated Mines Co. and the Silver King Coalition Mines Co. The former includes the Park Utah, Park City, and Ontario properties, and the latter includes the Silver King Consolidated Mining Co. Several smaller properties are in operation. Production from the district totaled 6,336 tons of ore and concentrates for the week ending June 4, 1926, of which Park Utah shipped 4,203 tons; Silver King Coalition 1,788 tons, and Ontario 345 tons. Somewhat less than 2,500 men are employed in the district, which rough estimate includes teamsters and others.

Park Utah is operating through the Ontario drain tunnel and other adits which connect with shafts. Milling ore to the amount of 450 tons per day is treated in the Judge mill, where separation is made by jigs and tables, with supplementary flotation. Lead concentrates containing 6 per cent zinc are shipped to the lead smelters; zinc concentrates are sent to Great Falls, and a zinc-iron concentrate containing 5 per cent lead is shipped to Tooele for retreatment. The shipping ore is sent to Tooele. Minor improvements have been made at the mill. A new wire-rope tram to the Ontario loading station was placed in operation in January and has eliminated hauling of concentrates and supplies. A new boiler with coal-dust firing accessories was also installed at the Judge mill. In the Judge mine a new pump station has been placed on the 1,800 level to lift to the 1,500 level.

Silver King Coalition is mining about 500 tons per day, milling 450 tons per day, and shipping 4,500 tons of ore and concentrates per month, lead concentrates going to Murray and zinc to Oklahoma. Jigs and tables with supplementary selective flotation are used in milling. The Silver King shaft is 1,550 ft. in depth, and connection has been made with the Silver King Consolidated adit. The old shaft house at the Silver King shaft is to be torn down and a modern steel building erected in its place.

At the Keystone development work is in progress. An adit about a mile long connects with a 500-ft. incline, from which development workings are extended. The mill, which is equipped with rolls, jigs, and tables, is not in operation. When producing, lead concentrates are shipped to Murray and zinc middlings to Midvale.

Tintic District

A total of 175 carloads of ore is shipped weekly from the Tintic district, distributed as follows: Tintic Standard, 48; Chief Consolidated, 36; A. S. & R., 42; Bingham Mines, 2; Plutus, 10; Iron King, 8; Yankee, 2; Silver Park, 1; Mountain View, 1; Colorado, 1; Dragon, 1; Bullion Beck, 1, and Mammoth, 1. During the first quarter of the year Tintic Standard produced 4,624 tons of lead and 946,578 oz. of silver, an increase over the corresponding period of 1925. Shipments are steadily maintained from this important mine. The mill at Harold is not in operation.

The Chief Consolidated Mining Co. converted its flotation mill to differential flotation and placed it in operation on May 7. It has a capacity of 300 tons per day and handles ore produced from No. 1 shaft below water level. About 200 tons per day are being treated, the production being 700 tons of zinc and 400 tons of lead concentrates per month. Zinc concentrates are shipped to Great Falls and lead concentrates to Midvale. The volatilization plant also

Ore-hauling equipment of George W. Moore, one of the many

operated by the Chief Consolidated is treating tailings from Eureka Hill and making a small profit. Operating difficulties at this plant are being overcome. Development of the Apex Standard has been discontinued and a development plan is under way on the Eureka Lily property. Practically all construction work has been completed.

Tintic district is employing about 1,800 men. Leasing is under way at a number of properties. At the Ophir Hill Consolidated, Ophir, development has been suspended and a station is being cut at the end of the adit, from which a 1,200-ft. shaft is to be sunk.

Butterfly-Terrible Again Producing

The old Butterfly-Terrible mining property, Ophir, Colo., is now operating both mine and mill. This property has been placed among the producers of the county within the last year, following a year of heavy expenditure by the stockholders of the company. In addition to the power plant, the company has cleaned up the old milling plant, added flotation machines, and is cleaning out and getting other parts of the mine in condition for operation.

The Butterfly Consolidated Mines, Inc., is the owner of the property. This company is the outgrowth of the old Matterhorn Mining & Milling Co., which operated the old Matterhorn.

Vanadium Minerals Discovered Near Magdalena, N. M.

The Rare Ores Co., operating at Magdalena, N. M., recently struck a vein containing vanadium minerals, with some gold and silver. The combined value of the ore is said to be approximately $70 per ton. This ore was found at a depth of 36 ft. The vein is being crosscut.

Newlife Mining & Milling Open Old Mine

The Newlife Mining & Milling Co., Rollinsville, Colo., is starting operations on the Smuggler mine, and has outlined considerable new development. The property was worked profitably about ten years ago, and has the record production of several hundred thousand dollars in gold. It is located southwest of Rollinsville, in South Moon Gulch. Walter E. Burlingame is in active charge of operations.

Ore Hauling an Important Business in Joplin-Miami District

Every week approximately 15,000 tons of zinc and lead ore are shipped from the Joplin-Miami district. In only a comparatively few instances are mines located on railroad switches, so that loading can be done right at the ore bin. At most properties it must be loaded into motor- or horse-drawn trucks or wagons, hauled to the railroad cars and unloaded.

Ore hauling is thus a considerable business, averaging around $5,500 to $6,000 a week. This cost is paid by the smelter purchasers of the ore, which is all bought in the bin. Standard charges are made by the ore-hauling companies. For short hauls it is 50c. a ton, and for the longest, where the distance may be several miles, it is $1 a ton.

There are a dozen or more companies or concerns which make ore hauling their exclusive business, with investments amounting to as much as $30,000. Some ore haulers, however, make it a side line business. George Moore, of Joplin, formerly representative of the American Metal Co., is one of these. He is one of the veteran ore buyers of the field, and also has been connected with some private mining enterprise most of the time. Last year he suffered a loss of about $15,000 when $30,000 worth of ore-hauling equipment, including eighteen fine teams of horses, were lost in a fire at Picher, Okla. Only one-half the loss was protected by insurance.

The greater part of the hauling is done with horses, although many motor trucks are used. Only on the long hauls, however, are motors considered more economical. Furthermore, in many cases roads at the mines are not all they should be, and horses are deemed more reliable.

A few smelting concerns haul their own ore. That is, they maintain their own ore-hauling equipment. Most of them, however, depend upon independent ore haulers.

Hollinger Enlarges Operations

The Hollinger Consolidated Gold Mines, Ltd., Timmins, Ontario, is making steady progress with its plans for expansion. About 20,000 hp. is now being consumed in operations. Three shafts to a depth of 3,000 ft. each will give access to the ore deposits. Nearly a score of additional shafts will eventually be used.

According to an official statement the aggregate output up to the end of the present year will stand at $115,000,000. Dividends of $35,000,000 will have been distributed, and surplus will be close to $12,000,000. In addition to this, the development of the mine, with ore reserves of more than $60,000,000, has been paid for, and a plant of $8,000,000 will have been largely written off.

The first 700 ft. in depth of Hollinger has either yielded gold or contains a balance sufficient to make up the entire output up to this time. In the general scheme of mining, the first 3,000 ft. in depth represents the first stage because of the fact that a depth of 3,000 ft. is considered the economic limit of hoisting in one vertical lift.

As regards work below that horizon, it is intended that the sinking operations will be located centrally in the area of mineralization, and it is proposed to duplicate the hoisting appliances now used on the surface at that level. Great excavations where ore will have been taken out will be used as underground chambers, where workshops will be established and where repair work can be done on the machinery used on the lower levels.

Atlas Tunnel Advanced 311 Ft. in July

The tunnel of the Atlas Mining Co., at Mullan, Idaho, was extended 311 ft. in July, making its total length 4,756 ft. The July advance is comparable with 364 ft. in June.

An objective of the tunnel is a point a short distance beyond the cropping of the Idaho Giant, which is a part of the Idaho Carbonate Hill and 1,600 ft. distant.

Regular Copper Shipments via Panama Canal

Shipments of copper from Arizona smelters to the Atlantic seaboard refineries via Los Angeles and the water route through the Panama Canal are now being made at the rate of 200 tons every five days. The freight rate by the all-rail route is $12.50 per ton, and by the new route is said to be about $1 less at present. Arizona mining companies and Los Angeles shipping interests are co-operating in an effort to obtain a reduction in the rate of $6 per ton for the 500 mile haul from Arizona points to the Los Angeles docks. It is expected that shipments of copper by the water route will reach 100,000 tons per year by Jan. 1.

firms engaged in transporting concentrate in Joplin-Miami district

News From Washington

By PAUL WOOTON
Special Correspondent

Expansion of Bureau of Mines Depends Entirely Upon Action of Budget Director

ALL of the ambitions and plans for an expanded and more effective federal service to the mining industry now are in the balance. Budget officers hold the scales. Secretary Hoover's efforts to stimulate and encourage mining by having the government perform more of those helpful tasks which the industry cannot readily undertake for itself are dependent upon additional appropriations. Funds now at the disposal of the Bureau may be spent only for specific and detailed purposes. New money must be had for new functions. Nothing impresses budget officers or members of appropriations committees so much as the knowledge that the proposed work has wide public support. When an appropriation is proposed for agriculture it comes in for a degree of sympathetic consideration that is entirely lacking when the money is to be expended in behalf of the mining industry. This is due largely to the fact that the mining industry, with a relatively small personnel, does not have the articulation that is possessed by agriculture.

The principal reason for the lack of support for mining appropriations is due to the fact that the public regards them as beneficial only to the producers of minerals. It has failed to grasp the fact that the manufacturers who use the raw mineral materials and the ultimate consumers of the manufactured products benefit quite as much as do the producers.

Take, for instance, the scientific and engineering work done on petroleum. The future of the automobile and of the internal-combustion engine depend on the success of engineers and scientists in finding means of keeping petroleum production abreast with consumption or in devising substitutes for petroleum.

Though it is clear that there is no immediate shortage of petroleum in sight, yet all responsible observers agree that constant improvement of the technology of oil production and refining are the only things that can prevent a great rise in the price of gasoline. The present rate of automobile production depends upon cheap motor fuel. The industry has built up an enormous capacity for manufacture, and is now eagerly seeking an export market. A cheap supply of fuel is by far more important than the capture of new export markets. For this reason the automobile manufacturers ought to be actively supporting the petroleum work of the Bureau of Mines. Many of them never heard of it, but all of the fault is not theirs. Little effort has been made to call it to their attention.

The automobile manufacturer is only one indirect beneficiary of this work. There are thousands of others. In like fashion all of the new work being planned by the Bureau benefits others than the producer. The tasks have been selected after careful deliberation with the industry directly concerned, but all the thought and work which have been given the matter and all of the value of Secretary Hoover's experience and foresight may go for naught if some subordinate budget official fails to grasp the significance of the proposed work.

Those who are in charge of government work are precluded by iron-clad regulation from calling upon outside support for their plans. The press and the trade associations are about the only agencies which feel free to make pleas for support for appropriations. This very article may cause General Lord, the vigilant Director of the Budget, to send for me to hear again my pronounced views on what he terms "conspiracies against the United States Treasury."

Such animadversions are not taken very seriously by representatives of agriculture, who frequently approach the Treasury with designs on millions. At the last session they were thrown a sop of $225,000 in an effort to head off larger demands. This is in decided contrast with the treatment which will be accorded a request for $100,000 or $200,000 additional for the mining industry, which went deeper in the slough of business depression than did agriculture.

An unusually large proportion of the staff of the Bureau of Mines hold degrees in engineering. Director Turner feels that this is one of the assets of the Bureau, and the term is to be incorporated in titles wherever possible.

In the new plan of organization the head of each branch is to be called the chief; the head of each division is to be known as chief engineer; the head of each section is the supervising engineer; and the head of each unit is the engineer-in-charge. This form of descending scale will be carried out as far as possible in the entire scheme of organization. Under the new arrangement the roster of the principal members of the Bureau of Mines staff, with titles as now assigned, is as follows:

Scott Turner, director; Joseph H. Hedges, assistant to the director; John D. Secrest, chief clerk; Carl E. Julihn, chief engineer, information service division; O. P. Hood, chief of the technologic branch and chief engineer of its fuels division; Harry H. Hill, chief engineer, petroleum and natural gas division; Roscoe A. Cattell, chief engineer, helium division; Daniel Harrington, acting chief engineer, mining research division; Dorsey A. Lyon, chief metallurgist and supervisor of stations; Charles E. Munroe, chief explosives chemist; George S. Rice, chief mining engineer; Charles P. White, chief of the economics branch and head of its coal division; Frank J. Katz, chief engineer, mineral resources and statistics division; Frank L. Hess, chief engineer, minerals and metals division; Harry H. Hill, chief engineer, petroleum economics division; Royd R. Sayers, chief of the health and safety branch and chief surgeon of the Bureau; Daniel Harrington, chief engineer, safety service division.

The superintendents of the field stations, all of whom are engineers, at present are as follows:

A. C. Fieldner, central station, Pittsburgh; Nicholas A. C. Smith, petroleum station, Bartlesville, Okla.; Oliver C. Ralston, Pacific station, Berkeley, Calif.; B. W. Gandrud (acting), southern station, Birmingham-Tuscaloosa, Ala.; Chauncey F. Cook, helium plant, Fort Worth, Tex.; Thomas L. Joseph, north central station, Minneapolis, Minn.; Oliver Bowles, nonmetallic station, New Brunswick, N. J.; Edmund S. Leaver, rare and precious metals stations, Reno, Nev.; H. M. Lawrence (acting), Mississippi Valley station, Rolla, Mo.; Thomas Varley, intermountain, station, Salt Lake City, Utah; Byron M. Bird (acting) northwest station, Seattle, Wash.; Eugene D. Gardner, southwest station, Tucson, Ariz.

The field offices of the Bureau are manned at present as follows:

Clifford P. Bowie, San Francisco; Joseph W. Horne, Boulder, Colo.; George E. McElroy, Butte, Mont.; H. B. Hill, Dallas, Tex.; E. H. Denny, Denver, Colo.; Kenneth B. Nowles, Laramie, Wyo.; Frank W. Davis, Lincoln, Neb.; Arthur W. Fahrenwald, Moscow, Idaho; D. C. Ashmead, Wilkes-Barre, Pa.; John S. Desmond, Rifle, Colo.; Benjamin D. Stewart, Sitka, Alaska.

Those in charge of the field offices of the mineral resources division are:

Charles W. Henderson, Denver, Colo.; John P. Dunlop, Joplin, Mo.; Victor C. Heikes, Salt Lake City, Utah; James M. Hill, San Francisco, Calif.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Dome Production Decreases as Ore Grade Is Reduced

The recent visit of H. P. De Pencier, general manager of the Dome, to the Red Lake district has revived talk of the company's future plans in this field. It is believed, however, that the visit was not so much in connection with operations on the Howey property as on the Red Lake Prospectors' ground which the company has under option and on which it has done a large amount of surface work. It is understood that the results of this work have not been particularly encouraging. No move has yet been made toward bringing a plant into the Howey. Tenders have been called for but no contracts have been let.

July production figures of the Dome show a total recovery of $320,042 from 47,305 tons milled. This is an average of $6.76 a ton. Though the tonnage treated constitutes a monthly record in the history of the mine, the average recovery per ton was the lowest for many months, and compares with $7.47 in June and $8.31 in July, 1925. The recovery showed a decrease of $6,700 compared with the previous month. It is not expected that there will be any material improvement in the grade for some time. The company has a large tonnage tied up in sills and pillars, but the best of this ore will have to be left until more distant stopes of lower-grade ore have been cleaned up. Those interested are at last beginning to realize that the official statement regarding the mine was not the result of undue pessimism. The management has simply been telling the public unpalatable truths without attempting to hide anything, and the impression got around that the mine was practically finished. The probabilities are that the property will be operating for years to come, but on a reduced tonnage and probably lower grade as compared with the past. The company is in good condition and has over $4,000,000 in the treasury.

At the Vipond mine, Timmins, Ont., July production amounted to $54,242 and the daily tonnage treated was 239 tons. This is a considerable increase over the previous month, and it is expected that the tonnage will soon be raised to 300 a day.

Development Continues at Gowganda

The Castle property, in Gowganda, is producing silver at a rate of 1,000,000 oz. a year, and should be in a position to start dividends soon. At present the surplus amounts to about $300,000. The mill of the Tonopah property, at Gowganda, is expected to start operating about Sept. 1, making this the third mill in the district. Operations have been started on the Plata mine, a subsidiary of the Noranda, where a shaft will be sunk to 300 ft. The property has been equipped with a complete electric mining plant.

The Keeley property, in South Lorrain, produced in July 125,018 oz. of silver and 29,554 lb. of cobalt. At the eleventh level a shoot of ore has been opened up on No. 28 vein for a length of 67 ft. and shows 2,100 oz. of ore over a width of six inches. An extension of this ore has been found within the last few days, showing a width of high-grade ore up to ten inches. This discovery is extremely important on account of the fact that it is on the lowest level so far opened up on this property. The Canadian Lorrain, which is controlled by the same interests as the Keeley, recently received returns of $40,000 from a thirty-ton car of high-grade ore, being the first shipment from this property. Good progress is being made with the construction of a mill, which should soon be in operation. Silver producers are somewhat concerned about the lower prices prevailing for silver, but it will have a really serious effect on only one or two properties which are handling low-grade ores.

Rouyn Railway Work Rushed

Contractors engaged in the construction of the branch line of the Canadian National Railways from O'Brien to the Rouyn area are increasing their forces with a view to the completion of the work before the end of November. About 1,000 men are now engaged on the work, and more are being taken on. Sixteen miles of the track has already been laid, and it is probable that the line will be completed before winter so as to allow the transportation of heavy freight, enabling the equipment for the Noranda smelter to be brought into the district.

Placer Mining Being Revived in Arizona

A large power shovel has been received by the Lynx Creek Mining Co., for handling auriferous gravel in the channel of Lynx Creek, Arizona. The material will be delivered by the shovel to large sluice boxes, the gold to be caught above riffles, after the pioneer method. Several miles of the bed of Lynx Creek, which is a few miles from Prescott, were recently taken under option by Los Angeles interests.

Below Octave, Ariz., in the Congress Junction district, the U. S. Smelting Co. is operating two churn drills, sampling a large gravel area. Two shafts have been sunk about 50 ft. to bedrock for better sampling.

Attempts are also being made to work some of the Greaterville placer country, which has been handicapped in the past through lack of water. A dry rocker is being used at present, and the outcome of these tests will be watched with interest.

Bentonite Discovery Reported in Wyoming

H. C. Timmerman, Kaycee, Wyo., reports the discovery of a large deposit of bentonite in Johnson County, Wyo. The mineral outcrops in many places, and has been penetrated ten feet. It is 35 miles from the Salt Creek oil fields and 85 miles from the refineries at Caspar.

London Letter

By W. A. Doman

Special Correspondent

Fluctuation of Franc Felt in London Mining Shares—Tin Nearing £300 Price

London, Aug. 3—It is not difficult to trace a connection between the prices of mining shares on the London market and the fluctuations of the franc. Although the sale of francs is forbidden in France, there are ways of evading the order, one being the purchase by banks of foreign currencies, and another the purchase by speculators of securities on the London market. The Frenchman has at last come to see that the stable currencies are dollar and sterling, and various subterfuges are employed in order to secure the one or the other. While the franc in relation to the dollar and sterling was depreciating, there was a rush for all sorts of mining shares, but since the return to power of M. Poincaré and the promulgation of his drastic measures for placing France in a better financial position, with the consequent fall of the gold currencies in terms of francs, many speculators have been selling shares. This again has had a somewhat adverse effect upon the London market, mainly of course in connection with mining and finance shares in which dealings take place internationally.

Two important factors which interest America are rubber and tin. The tussle to keep the price of rubber above a certain point in order that the 100 per cent production may be maintained has now ended, and the price of rubber is falling away again. The one matter having been settled, it is said that the attention of financiers is to be directed to tin. The price of the metal is now within measurable distance of £300, which figure it reached earlier in the year and which is expected to be attained again. Metal statistics for July have just reached me and show tin stocks to be 1,111 tons only, against 1,890 tons at the end of June and 4,828 tons twelve months ago. As the metal is a heavy commodity to carry, manufacturers are none too well provided, and some of the tin-plate mills are not in operation. Though substantial profits can be earned with tin at £250 per ton—and by some companies at £200—producers do not look for any substantial fall in price, although with several companies being formed, and others increasing their areas and their productive capacity, the output may be enlarged.

Naturally, the present price is stimulating the investigation of reported deposits in different countries, and a company named the Gonda Tin Mines, Ltd., has been formed to acquire mining concessions near Ancora, in the district of Biana do Castelo, in Portugal.

The Lokris Nickel Co., Ltd., has been registered, with a nominal capital of £770,000, to acquire the Lokris nickel mines, in Greece, and the benefit of a concession contract between the Greek

Government and the Middle East Development Corporation. So far no information beyond the registration particulars has been published, but this appears to me to be the nickel property which Hugh F. Marriott has been investigating and for which negotiations have been pending for two years or so. No mention is made in the particulars of Mr. Marriott's name, though it is to be assumed that if he has reported favorably he would be asked to see the matter through, as his judgment would naturally carry great weight with the investing public.

Some time ago I mentioned that certain people connected with base-metal companies in Rhodesia were shaking their heads at the manner in which shares were rising, such rises being entirely unjustified by the present position or by immediate prospects. P. K. Horner, the consulting engineer of Minerals Separation, Ltd., the general managers of the Rhodesia Minerals Concession Co., is now in Northern Rhodesia and will visit the company's concessions and examine the work that is being done. It is officially stated that prospecting in the original concession has as yet yielded nothing of outstanding importance, but several discoveries are worthy of further investigation. Prospecting is also to be undertaken in the new concession.

Indian Currency Commission Recommends Gold Bullion Standard

The report of the Indian Currency Commission, which has just been made public, makes recommendations as follows, according to a cable to the U. S. Department of Commerce: First, the establishment of an absolute gold-bullion standard, effective in 1931; gold not to circulate as money and sovereigns not to be legal tender; the present currency note and rupee circulation to remain and be convertible into standard gold bars. Second, the creation of a new central reserve banking institution to become operative not later than January, 1929. Third, that the rupee be stabilized in relation with gold at 18d. Fourth, that the reserve bank be legally obligated to buy and sell gold at gold points, not later than January, 1931, and that during the transition period the government be legally obligated to perform this function. The government approves at once the recommendation regarding exchange and views the other items favorably, it is reported.

Grasselli Acquires Pyrite Mine in Ontario

The Grasselli Chemical Co., Cleveland, Ohio, has acquired the John Holdsworth pyrite properties near Hawk Junction, Algoma district, Ontario, and has let a contract for drilling. Two drills will be placed in operation immediately. The Holdsworth property is regarded as the highest-grade pyrite property in the district, and one of the best in Canada. Its acquisition by the Cleveland company has resulted in a substantial advance in the prices of other pyrite properties.

Melbourne Letter

By Peter G. Tait
Special Correspondent

Hampden-Cloncurry Mines for Sale—Tasmania Reorganizes Department of Mines

July 1 — The Hampden-Cloncurry Copper Mines is advertising the sale of its mines and smelting plant, in the Cloncurry district, North Queensland. Owing to the low price of copper the mines have been closed down for several years. The company was registered seventeen years ago, and in the intervening period acquired a number of mines in the district. Some time ago proposals were made for an amalgamation of the Hampden-Cloncurry, Mount Elliott, and Mount Cuthbert groups, but these negotiations fell through. The Hampden company treated altogether 690,000 tons of ore and won 51,000 tons of copper, 21,000 oz. of fine gold, and 380,780 oz. of fine silver. The Mount Elliott company, in the same district, is engaged on the erection of an electrolytic plant to treat fifty tons of ore per day by the Mackay process. The Mount Morgan is operating on a small scale. The State Smelters at Chillagoe are closed down.

The Electrolytic Zinc Co. is developing the Read-Rosebery group of mines on the west coast of Tasmania. There is no doubt that an immense tonnage of ore is available, and it is rumored that a separate company will be formed to work them. It will be recalled that the company recently purchased the plant of the Metals Extraction Co. at Rosebery, adjacent to the Emu Bay Railway Co.'s Burnie to Zeehan line. The present outlet for the Read-Rosebery district is a narrow-gage railway which connects at Zeehan with the government line to Strahan. No announcement has been made by the company as to whether the treatment plant will be erected at Zeehan or Rosebery, but it is evident that by having two strings to its bow the company will be able to make a good bargain.

The Tasmanian Government recently reorganized the Department of Mines and appointed Mr. A. McIntosh Reid, geologist, as director. In an attempt to revive the industry Mr. Reid has recommended that the government should undertake the development of promising areas on condition that if the results warrant installation of a plant the leaseholders should refund to the government the money it has spent. An area in Tasmania that is attracting considerable attention at the moment is the Renison Bell tin field. Various companies have operated on this field for many years, but they have all been on too small a scale. Most of the rich sulphides have been mined, but a large deposit of pyritic ore is available. A. Victor Leggo & Co., of Melbourne, has been prospecting the district for some months, and it is proposed to form a company with adequate capital to treat the ore on a commercial scale.

There has been a rush to a new gold field in New Guinea, some miles inland from the Port of Salamoa. The country is jungle and very rugged, necessitating well equipped parties. Some alluvial gold has found its way to Sydney, but very little information is available.

Startling evidence was forthcoming at the inquest into the death of two members of the gold-stealing detective staff at Kalgoorlie, whose mutilated bodies were found in a deserted shaft. Three men are under arrest on a charge of murder: Clarke, hotelkeeper, of Boulder; Treffene, a barman at the hotel; and Coulter. According to the evidence Coulter and Treffene shot the detectives, and Clarke was an accessory to the disposing of the bodies. In the course of a statement Clarke admitted that he had been associated with the other men in the purchase of stolen gold.

Notes From New Zealand

There is little of interest to report from New Zealand. The Waihi company is still engaged on development and excavation work in its mine, but the general reserves at the end of last year's operations show a reduction of tonnage available which stands at 416,071 tons.

Considerable activity is to be noted on the old Thames mining field. Seven mines are working and several additional companies are being formed.

That small mines sometimes return good profits to the investor is well illustrated in the case of the Big River company, at Reefton, in the South Island of New Zealand. In eighteen years this property crushed 83,093 tons, for a yield value at £374,736 and paid dividends to the amount of £112,800, although the paid-up capital was only £600. An earlier company which worked the mine also paid £50,000 in dividends on an output valued at £113,984.

The latest news from the Kawarau River is to the effect that the dam has not yet been completed, but the engineer is hopeful that the work will be finished at the end of July. The Consolidated company is making arrangements to prospect the claims in the river bed as soon as the gates of the dam are closed.

The Shotover River suction cutter dredge is ready to start work, but owing to the low state of the river it cannot be floated into the stream. As soon as the snow melts operations will begin, but this may mean several months' delay.

Talc Production in 1925

The total quantity of talc mined in the United States and sold in 1925 was 182,256 short tons, valued at $2,011,793, according to a statement prepared by the U. S. Bureau of Mines. The figures comprise 5,684 short tons of crude talc, valued at $24,533; 895 tons of sawed and manufactured talc, valued at $107,691, and 175,677 tons of ground talc, valued at $1,879,569. They represent an increase in quantity of 2 per cent, and a decrease in value of nearly 10 per cent, as compared with 1924. There were twenty-three producers of talc in 1925, the same as in 1924.

Societies, Addresses, and Reports

Civilization and Prosperity Depend on Engineer

Retiring President of A.A.E. Emphasizes Importance of Profession to Society—C. J. Ullrich Defines Aims

Dr. D. B. Steinman, of New York City, in his presidential address before members of the American Association of Engineers, at its recent convention in Philadelphia, declared that engineering is the creative profession. "On no other class of men are we so dependent for our luxuries, our comforts, and even our necessities as we are upon the engineer and his work," he said. "The engineer is one of the most highly trained, practical, efficient, hardworking, creative, and indispensable servants of society. Of all professional men, he is the greatest contributor to the economic progress and wealth of the community." Dr. Steinman said further, in part:

"In this era of international economic competition, the wages of labor are ultimately determined by the efficiency of production, and national prosperity may be measured by the purchasing power of the workers' earnings. If American industries can compete in foreign markets while maintaining higher wages and shorter hours for our workers, that is only because of the greater efficiency of production in this country. This increased output of the individual worker represents the engineer's contribution to industry. Through the development and extension of labor-saving machinery, the scientific planning of plants and processes, the introduction of the principles of efficiency in management, organization and operation, the engineer has speeded up production, eliminated waste, and increased the output of the individual. The engineer has thereby made possible the higher earnings, the shorter hours, and the higher purchasing power of the workers' wages—all things that constitute the foundation of our national prosperity.

"Public attention is often directed to the depletion and approaching exhaustion of some of the natural resources which we have come to regard as indispensable. We are told that the end of our coal supply is in sight, that our petroleum supply will soon be consumed, that our timber supply is rapidly vanishing. It is the work of the engineer to prolong the availability of such fundamentally important natural resources through improvements in their economic utilization, through the scientific elimination of waste in production and application, and through the opening and development of new sources of supply.

"The proper recognition of the engineer as a professional man and of engineering as a learned profession is retarded so long as the title of 'engineer' is shared by non-professional men. The designation 'physician' and 'lawyer' are distinctive for their respective professions. But the title 'engineer' is commonly applied to men who operate steam engines or drive locomotives; and the resulting confusion and misunderstanding are further aggravated by the widespread and growing misappropriation of the designation 'engineer,' in multiplied hyphenated forms, by men who have no claim to an engineering title. We find plumbers placing 'sanitary engineer' on their signs. Electricians and bellhangers style themselves 'electrical engineers.' We also read announcements of 'domestic engineer,' 'clothing engineers,' 'exterminating engineer,' 'matrimonial engineers,' and a hundred or more other kinds of engineers, none of whom need to know anything about engineering science and its application. A consequence of this unhindered and indiscriminate use of the title 'engineer' is a weakening of its prestige and distinctive significance. The members of the engineering profession find that the use of their title 'engineer' does not invest them with the dignity and standing that are naturally possessed by the holders of other professional titles. Through education publicity we must conduct a persistent campaign to discourage the abuse of our professional title. Through registration laws, we must seek to restrict the use of the designation 'engineer.' We must stimulate and encourage revisions in nomenclature to distinguish between 'engineers' and 'enginemen.' The mechanic who drives or repairs a steam engine, however skilled he may be, should not be styled an 'engineer' to the detriment of the public standing of engineering as a profession.

"The American Association of Engineers is the only national organization devoted to the human side of the engineering profession. Its purpose is to bring engineers together in a professional brotherhood in mutual understanding, helpfulness, and co-operation. The advancement of this purpose alone is ample justification for the continued existence and growth of the association.

"Thousands of engineers throughout the United States are banded together in this organization. We are uniting our efforts to make pleasanter the relations and working conditions within the profession. We are seeking to relieve the engineer of economic pressure so that his best energies may be free for his high service to civilization and human progress. We are striving, through organized effort and publicity, to secure for the engineering profession its rightful place in public esteem, and for the members of that profession more adequate recognition and recompense for their services to society."

C. J. Ullrich, member of the firm of McGonagle & Ullrich, consulting engineers, Salt Lake City, Utah, was elected president of the American Association of Engineers for the ensuing year.

Mr. Ullrich began his engineering work with the Leonard Construction Company of Chicago immediately after graduating from college. In 1913 he was appointed Deputy State Engineer of Utah, which position he held until 1921. Since that time he has been a member of the firm of McGonagle & Ullrich. He is also an attorney-at-law, and confines his legal practice to engineering matters entirely. The new president, in a recent statement, said:

"The world of history is only about 6,000 years old, yet that 6,000 years represents by far more human progress than all the other ages through which man has ever lived. Who will dare say that the Great Pyramids, the Hanging Gardens of Babylon, the tunnels under the Euphrates, the Temple of King Solomon, or the cathedrals of medieval Europe were not constructed by the engineers of that day? So even our complex life of today is founded almost entirely on engineering achievements.

"Tregold has said, 'Engineering is the science and art economically applied to the laws, forces, and materials of nature for the use, convenience, or enjoyment of man.' The engineer is dealing with materials and forces, with objects of an inanimate nature and with the laws and forces acting thereon. His training and experience are apt to make him cold and austere in his ideas and beliefs and untouched by the human passions and feelings of the ordinary man. His training and experience also makes him individualistic in nature and when called upon to use men and enthusiasm to build up support for ideas and ideals, everything seems indefinite and as a rule he is lost. As a result, the engineer of the past has shrouded his work in an air of mystery. He has held his problems aloft from society. In the words of Tregold, 'If the engineer of today wishes to become successful he cannot like the engineer of yesterday retire into the technical recesses of his profession and content himself in being the servant of other men. He must be broadminded, aggressive, alert, and in touch with the problems of the public and society, and above all he must be a leader.'

"The engineer should hold it his duty to take part in the political problems of his community. Ours is the greatest and most liberal form of government in the world and it is our duty first of all as citizens and second as engineers to see to it that our government is maintained and nurtured by a politics that is clean, wholesome, and progressive. This can only be done by the citizenry of the country taking an active interest in politics, and by this I mean the better class of citizenry, the thinking men of the day.

"The American Association of Engineers is one of the most forward steps that has been taken in the engineering profession for the last twenty years. Its organization is non-technical in purpose and it confines its activities entirely to welfare work along social and economic lines. Its policy platform is one of service. Service to the public and to the engineer. Through service it is endeavoring to get the engineer to take an interest in his state and in his community. Through service it is trying to improve the social status of the engineer. Through service it is trying to better the condition of the engineer and the profession. In short, it is a clearing house for the engineer to express himself on all questions of the day."

People You Should Know About

A. L. Flagg, of Phoenix, Ariz., was in New York last week.

T. J. Mateer, metallurgist for the National Lead Co., has left Salt Lake on a business trip to St. Louis.

J. R. Walker, president of the Walker Mining Co., has returned to Salt Lake from a three weeks' hunting trip.

Fred Searls, Jr., widely known geologist, of San Francisco, was recently in Wallace, Idaho, on professional business.

C. F. Kelley, president of Anaconda Copper Mining Co., is spending the summer at his country estate on Swan Lake, Mont.

S. M. Soupcoff, engineer for the American Smelting & Refining Co., has returned to Salt Lake from a tour of Nevada camps.

George H. Garrey, who returned to his office from Canada a few days ago, has gone to Nevada on geological examination work.

T. Schilowsky, London, England, metallurgist, recently spent a week at Salt Lake inspecting Salt Lake valley metallurgical enterprises.

Dr. Robert J. Anderson, consulting metallurgical engineer, of Cleveland, Ohio, has just returned from a two months' trip to the Pacific Coast.

John G. Kirchen, general manager of the Tonopah Extension Mining Co. at Tonopah, Nev., has returned to Tonopah from New York and San Francisco.

Hugh R. Van Wagenen, mining engineer, after a two months' trip to Colorado and New York City, is again at his headquarters office in Los Angeles.

Howard D. Smith, president of the Consolidated Coppermines Corporation, is in San Francisco in the interest of the company which he represents.

G. W. Lambourne, president and general manager of the Park Utah Consolidated Mines Co., and **J. A. McIlwee,** Salt Lake operator, are making a tour of Europe.

Lewis D. Knight, manager of the Ingersoll Rand Co., has returned to Salt Lake headquarters after a tour of Idaho, Montana, and Washington camps.

H. P. De Pencier, general manager of the Dome Mines, Ltd., is visiting the Howey property in the Red Lake area of northern Ontario to make another examination.

Bennett R. Bates, mining engineer, has resigned from the staff of the Dorr Co. to accept a position with a large industrial company with headquarters in New York.

T. G. Madgwick, formerly in charge of the oil department at Birmingham University, has been engaged by the Canadian Government to advise the Department of the Interior regarding oil developments in Alberta.

D. P. Rohlfing, consulting engineer, who during the last year has been conducting mine examinations of properties in and about Aspen, Colo., for Eastern capital, has returned to this work after spending several weeks at Salt Lake.

D. H. Fairchild is making an examination of the Duplex mine, at Searchlight, Nev., for the owner, George R. Colton. The examination bears particularly upon the possibility of devising a process that will successfully treat the ore to recover minerals complexly associated in it.

Chauncey L. Berrien

Chauncey L. Berrien, general superintendent of mines of the Anaconda Copper Mining Co., has returned to Butte after spending several months at the Giesches Erben zinc property in Germany and Poland.

A. C. Oberg, of St. Paul, mining engineer for the State Securities Commission of Minnesota, was in Wallace, Idaho, Aug. 7 to investigate the property of certain mining companies doing business in Minnesota. From Idaho he went to Colorado.

Edward Thornton, vice-president of the Southwestern Engineering Corporation, of Los Angeles, is making an extensive trip through the mining districts of the Southwest, including Kingman, Prescott, Yuma, and Tucson, Ariz., and El Paso, and will then spend some time at the company's branch office and factory at Tulsa, Okla.

Philip S. Smith, of the Alaskan Branch of the U. S. Geological Survey, has sent to the Survey by radiogram via the Coast Guard steamer "Bear," at St. Paul, Alaska, the following message: "Aug. 1. Returned to Wainwright, having finished work to northeast. Leaving for twenty days' work to northwest. Expect then to return to Nome."

Walter K. Mallette will superintend the construction of the new electrolytic zinc plant which will be built by the Bunker Hill & Sullivan Mining & Concentrating Co. at Kellogg, Idaho. Mr. Mallette was formerly in charge of the construction of the Bunker Hill smelter, which was completed in 1918, and for the last three years has been superintendent of construction for the American Smelting & Refining Co. at San Luís Potosí, Mexico, where this company has recently completed an arsenic plant and smelter.

Richard H. Rosewarner-Rochester, or **R. H. R. Rochester,** or anyone knowing him or his address, should communicate at once with Miss Florence L. Sullivan, 638 East Town St., Columbus, Ohio. Important matters require his attention. He was last heard from in 1923, when he was engaged in opening a mine at Hermosillo, Sonora, Mexico.

Robert Hawxhurst, Jr., directs attention to the fact that two inaccuracies appear in his communication discussing the origin of Chilean nitrate, which was printed in the July 31 issue of *Engineering and Mining Journal.* The words "this phenomena" should have been rendered "this phenomenon," and the reference to "hydrogen ore" should have read "hypogene ore" Mr. Hawxhurst's copy was correct. The errors were perpetrated by the composing room and the proofroom.

Obituary

Dr. W. L. Uglow, professor of mineralogy at the University of British Columbia, died at his home in Vancouver on Aug. 3, as the result of spinal injuries received while he was bathing two months ago near Honolulu, where he was spending a holiday. Professor Uglow was a graduate of Queen's University, Kingston, Ontario, and for several years he was on the Geological Survey of Canada.

William Cantner Chapin, mining man, publisher, soldier, and capitalist, died at San Francisco on Aug. 10. He was born in Penn Yan, N. Y., on Nov. 13, 1833, and was graduated from Jefferson Medical College in 1855. He went to California in 1868 and engaged in mining in that state and in Nevada. After the Civil War, in which he participated, he spent some years in Minnesota. He was associated with William Rockefeller and H. H. Rogers in the oil business. Returning to the West he became publisher of *The Sacramento Union,* of which his son, W. W. Chapin, is now publisher. Mrs. C. B. Collins, of Seattle, and Mrs. Harry George, of New York, daughters, also survive him.

Arthur Neustaedter, mining engineer and metallurgist, died at his home at Roselle Park, N. J., on Aug. 12. He was sixty-one years old. Mr. Neustaedter was graduated from the Missouri School of Mines in 1884, and the next year attended Vanderbilt University. He practised his profession in South Africa, Central American, the Philippines, Alaska, and various parts of the United States, being action in both metal and non-metallic fields. He is survived by his widow and four children, the oldest of whom is a son, Harold A. Neustaedter, also a mining engineer. Arthur Neustaedter was a member of the A.I.M.E. He had made a hobby of natural history and had accumulated some excellent collections during his travels.

Recent Technical Publications

Reviews, Abstracts, and References

An Old Standby Rewritten

Geology Applied to Mining: A first book of general Geology and Metallology. By J. E. Spurr. Second edition, revised and rewritten. McGraw-Hill Book Co., Inc., New York. 1926. Price, $3.

The author's original aim, as expressed twenty-one years ago—to state concisely those results of the science of geology which bear upon ore deposits—has been rigidly adhered to in the new edition. In its field this little book has stood alone, and it is safe to predict that its long enduring popularity will now be greatly enhanced; for the author has achieved a remarkable simplicity and clearness of statement, despite the technical nature of his subject.

Compared with the former edition, a marked improvement has been made by substituting for the question and answer method a series of brief, clear statements under numerous guiding heads and subheads. For the young geologist and engineer and for the non-technical miner and prospector, the value of these succinct topical headings can scarcely be overestimated. The same statement applies also to the 164 examples briefly described in connection with the text and the 124 illuminating illustrations, drawn from the literature and from the author's rich experience.

Of the 347 pages of text almost exactly one-third is appropriately devoted to an introductory discussion of rocks and their structures, under three chapter headings: I, Sediments and Sedimentary Rocks (including metamorphic sediments), 43 pages; II, Igneous Rocks and Magmas, 34 pages; and III, Bending and Breaking of Rocks, 38 pages. These various subjects are discussed under 34 heads and 187 subheads. The remaining two-thirds of the text is devoted to the main topic of ore deposits, which comprises the following chapters: IV, Deep-seated Concentration of Metals, 83 pages; V, Concentration of Metals at or near the Surface, 77 pages; VI, Ore Deposits and Geologic Periods, 12 pages; and VII, Ore Deposition as Controlled by Faults, Fissures, and Folds, 60 pages. These chapters include 33 heads and 257 subheads.

Naturally the author emphasizes his well-known views concerning the origin of ore deposits. In the discussion of theories, however, he first outlines the historically important ones, from the earlier views of leaching by ground waters to the more modern conception of magmatic emanations (pages 124-127). This is followed by a more extended statement of the author's later views concerning ore magmas and veindikes and their importance in the deep-seated concentration of metals. For the student, therefore, this book may be regarded as an introduction to "The Ore Magmas," by the same author, a treatise that is rapidly bringing about the critical examination and appraisal of our older hypotheses.

Entirely apart from theories, however, the new edition of this little book has a real value for the student, the geologist, and the engineer in its clear, concise descriptions of the types of ore deposits, their modes of occurrence, and their structural features.

The book is a little larger than the first edition, but it is still small and compact; and the high quality of the typography, presswork, and flexible leatheroid binding make it both attractive to the eye and pleasing to the touch. For a first printing the number of slips on the part of the copy reader and the proofreader is remarkably small, and none of these can confuse or mislead the reader. The reviewer is writing from the field, where classical authorities are not available, but he ventures to suggest that the word "metallology" in the subtitle might be shortened to "metallogy" ("metal" and "logos"), unless this form of the word has been pre-empted for some other meaning. J. VOLNEY LEWIS.

Raw Materials That Come from Abroad

Dependent America. By William C. Redfield. Houghton, Mifflin & Co., Boston and New York, 1926; pp. 253. Price $2.50.

This fascinating and instructive book is, as the title-page states, "a study of the economic bases of our international relations." The former Secretary of Commerce has produced a remarkable treatment of his theme, which is to show how the complex civilization of the United States, especially the unavoidable material civilization, rests inextricably upon the combined efforts of the labor and the products of the countries of the whole word. The aim of the book is to combat the imaginary self-sufficiency of the United States, and to show, as it does truly, that our every-day life would fall into hopeless confusion were we indeed isolated. The lesson is driven home by case after case, by facts and by figures, so that it is far from being dubitable as presented. The great export and import trade of the United States, which is so commonly disregarded by our citizens and politicians when it comes to considering the international politics and relations of the United States to the rest of the world, is here for the first time lucidly analyzed in a popular way. The very complexity of American material civilization renders it more dependent on the whole world than is any other country.

From the Far East, for example, America must draw shellac, jute, and rubber, materials necessary to every household. In linoleum and oilcloth, for example, are jute from India, cork from Algeria, and linseed oil from the Argentine. In considering "our greatest industry," the steel industry, the author points out that forty commodities brought from fifty-seven countries are used, among them many mineral commodities, including such essential steel-making metals as manganese, chrome, and nickel, the situation in which is familiar to our readers. Our leather industry, the largest in the world, is largely dependent upon far-off lands both for hides and tanning materials. In general we get half our calfskins abroad, over one-third our hides, all our goatskins, and nearly two-thirds our sheepskins. Turning to family supplies, and using a familiar example, we import each year a million miles of sausage casings! We import annually nineteen million pounds of butter from fourteen countries, and fifty-nine million pounds of cheese from twenty-one countries. So far as our supply of tin is concerned, our readers are well aware that it is all imported, although the general public to which Mr. Redfield addresses himself does not yet know this.

As for our press, we are dependent on foreign countries for our paper; in 1923 one-third of the paper pulp was imported; and nearly one-fourth of the domestic production was made from imported wood. As for needles, none are made in the United States: all come from Germany, England, or Czechoslovakia; nor is cork grown in the United States. These are random examples of domestic necessities.

Turning to the question of national defense, the author cites our War Department as listing thirty specific materials "which are called strategic because they are essential to the prosecution of war, and because we either do not produce them at all or can supply them in quantities which are insufficient even for peace-time requirements." Thirteen of these are mineral commodities.

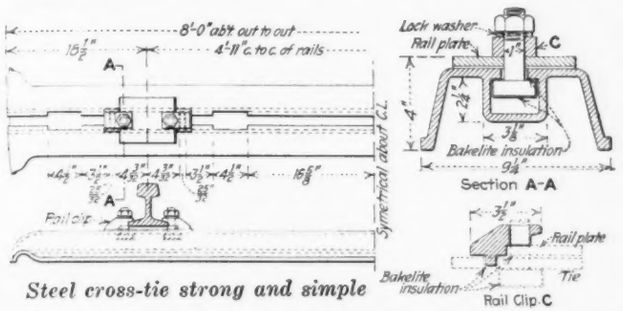
The conclusions which are drawn from these facts are plainly and forcefully stated. Quoting the Apostle Paul that "God has made of one blood all nations for to dwell on the face of the earth," he shows the actual international development of the present day—not only in the material things which he has cited, but in music, science, art, literature, and even religion. Nationalism, it is implied, has its splendid uses, and must always survive; but it is nowadays insufficient.

As for our economic self-sufficiency, Americans may reasonably talk about it "when and only they are prepared to abandon all or part of many things of constant use such as telephones, electric lights, radio, phonograph, carpets, linoleum, newspapers, railways, automobiles, brushes, bagging; linen, woolen and silk clothing; shoes, and the doormats upon which our shoes are wiped." Sport and even finance have become international. "It is both amusing and pitiful to see politics lingering with reluctant feet, hesitant, fearful to enter where others tread, not only with safety but with advantage. Our resources are not those alone which we ourselves unaided have developed. Our wealth is not wholly self-made, our power is not only self-created. . . . Our prosperity is shared by the men and women of all continents. . . . There adversity reacts hurtfully upon us, and neither they nor we can prevent its doing so." J. E. SPURR.

New Machinery and Inventions

Latest Steel Cross-Tie Is Simple in Construction

The latest and most important development that has been made in the Snyder steel tie, now known as the Keystone copper steel tie, has been the elimination of all holes, rivets and other weakening points in the channel section itself. The tie is a special channel section which includes a strong and reliable reinforcement consisting of an inverted central channel or depression with an overhanging shoulder structure extending over the central channel. The rail fastening device is simple and possesses a positive holding power which is claimed to eliminate disadvantages formerly experienced in other steel tie rail fastenings. The bolts used are fastened from the top of the tie, thus facilitating rapid installation and change of rail.



Steel cross-tie strong and simple

The Keystone Metal Tie Corp., New York City, manufacturer of this tie, has a new process for rolling steel channels with an overhanging shoulder structure, and since this method requires but four passes through the rolls, an exceptionally reasonable price on the ties is said to be obtained.

Acetylene Generator Safe

A portable acetylene generator built by the Bastian-Blessing Co., 240 East Ontario St., Chicago, has been tested by the Underwriters' Laboratories, Chicago, to show its safety and reliability under a number of extreme conditions. In one test that was made a fully charged generator had one wheel raised 21 in. without the generator tipping over.

In another test the front end of the truck was raised 66 in. without causing a tip-over. In another, the generator was thrown on its side and left for 15 min., and upon being returned to the proper position the gas valve was opened and the generator operated satisfactorily; it had been set to producing gas at 10 lb. pressure before being thrown over, and water and gas were expelled through the blow-off valves without damage. In another test the generator carbide feed was locked, and, upon being thrown on its side, the pressure in the generator did not build up and the machine was again put into operation on being brought into the upright position. The company has developed the portable generator for medium-pressure work.

New Wall Tie Blocks Used in Building Furnaces

In these days of high duty operation in the boiler plant, furnaces of comparatively large volume call for higher and thicker walls, imposing loads as high as 40 lb. per sq.in. on the firebrick. When to this are added the stresses due to lateral expansion and often the load of combustion arches and powdered-coal burners, in conjunction with high furnace temperatures, the results are such that it has been necessary for the manufacturer of firebrick to sacrifice refractoriness to obtain unusual load-bearing qualities.

To obviate this undesirable situation, the Chicago Fire Brick Co., 111 West Washington St., has developed the "Chico" wall tie blocks to divide the firebrick lining into self-supporting sections and transfer the weight to the outer bearing wall of ordinary brick. With the usual proportion of nine courses of firebrick to one of tie blocks, shown in Fig. 1, the maximum compression on any brick does not exceed 1.7 lb. per sq.in., so that there is an ample factor of safety to give a choice to any type of brick preferred.

The blocks are made in one size and shape, with tongue-and-groove keys which interlock only when the blocks are staggered and in alignment. They are of the same length, but twice the width and thickness of the standard 9-in. firebrick, so that they are equivalent in volume to four bricks. The weight of each block is 29 pounds.

It will be seen that every section of nine courses of brick and the attending course of tie blocks is self-supporting and independent of every other section, so that replacement at any particular location will not disturb the balance of the wall. The tie blocks extending to the fire face can be renewed as readily as the brick without disturbing the tie blocks extending into the setting wall. As the blocks carrying the load of a section are protected from the fire, they are not subjected to severe service and should remain in place indefinitely without disturbing the tie between the lining and the supporting wall of the furnace. For the latter purpose the blocks are preferable to firebrick, owing to their greater rigidity and shearing value.

Where it is desired to use plastic firebrick furnace lining, the construction shown in Fig. 2 is recommended. The tie blocks are used to divide the wall into sections, giving it greater stability and transferring the load to the common brick. As plastic refractory walls can be fired only from one side, the thickness has been limited to 4½ in. Experience has shown that this thickness of wall can be matured without danger.

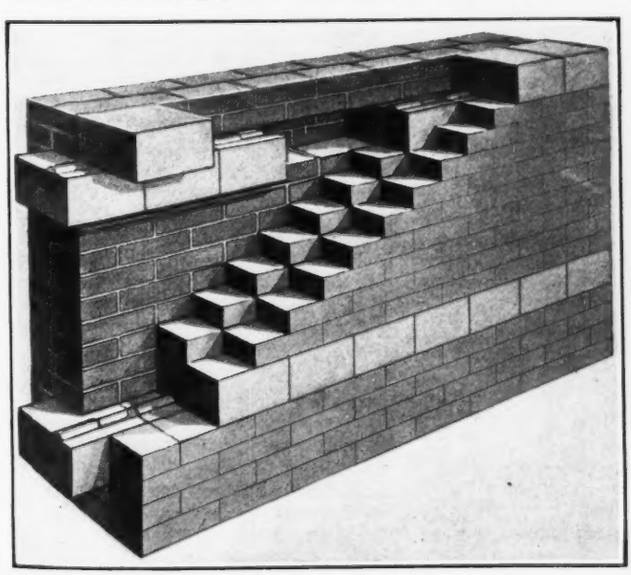


Fig. 1—Newly developed wall tie blocks and firebrick lining

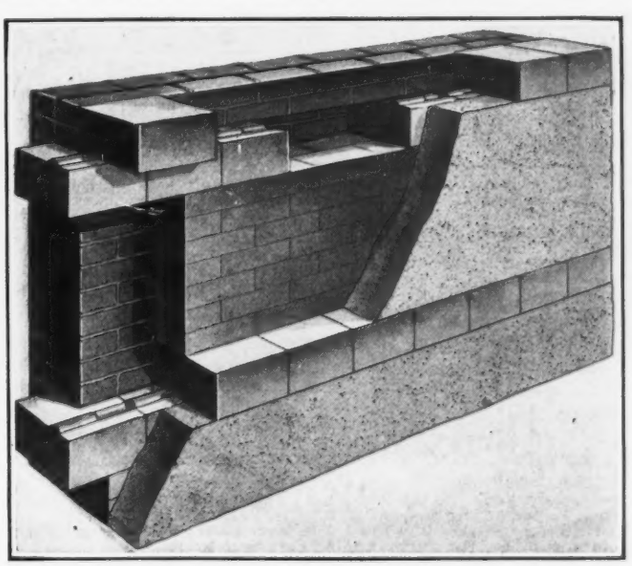


Fig. 2—Plastic firebrick lining with tie block support

The Market Report

Metal Markets Quiet and Steady

New York, Aug. 18, 1926.—The nonferrous metals have had a quiet week, without exception, with prices well maintained. Copper and zinc are very slightly higher in price, with copper sales in considerably greater volume than last week. The prices of lead, tin, and silver, on the other hand, are slightly less than a week ago.

Copper Sales Improve

The large copper producers have continued all week, except for two sales of moderate tonnages, to quote Eastern consumers at 14½c. and Middle Western at 14⅝c. Other sellers, however, shaded these prices materially, especially last Thursday and Friday, when an excellent tonnage of copper was sold at 14⅜c., delivered Connecticut Valley. In fact, some was sold as low as 14.35c., though this was offset by a little Middle Western business at higher levels. The large producers sold only an occasional carload. On Monday, with the improvement reported from London, and having sold a satisfactory quantity, sellers were no longer willing to quote 14⅜c. A small tonnage was sold yesterday as low as 14.40c., though Middle Western business was booked at 14⅜c. Today, various prices have been paid, from 14⅜c. delivered in the East, to 14⅝c. for a large tonnage in the Middle West. Consumption continues fully equal to production, but sellers do not expect a great deal of business until after Labor Day, as buying last month was heavy and many are away on vacation. The volume of sales this week has been almost twice that of last week, but still rather below the average. Foreign demand has been quiet, with dealers getting most of the business at 14.45@ 14.55c., c.i.f., while American agencies continue to quote 14.65c.

Daily Prices of Metals

Aug.	Copper N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
12	14.125	63 125	64 625	8 90	8.75	7.30@7.325
13	14.125	63 125	64 50	8 90	8 75	7 325
14	14 125	63 125	64 50	8 90	8.75	7 325
16	14 225	63 375	64.875	8.90	8.75	7 35
17	14.275	63 25	64.75	8.90	8.75	7.40
18	14 275	63 25	64.75	8.90	8.75	7.40
Av.	14.192	63.208	64 667	8.900	8 750	7 352

The prices correspond to the following quotations for copper delivered: Aug. 12th, 13th and 14th, 14.375c.; 16th, 14.475c.; 17th and 18th, 14.525c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Aug.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
12	58⅜	59⅛	66½	288½	283¾	32 9/16	32 3/16	33⅞	34⅜
13	58½	58⅞	66½	289	284	32⅜	32⅛	34	34 5/16
16	58⅝	59⅜	66¾	290¾	285⅝	32 11/16	32¼	34	34½
17	59⅛	59⅞	67¼	291	285¾	32⅝	32¼	34 3/16	34⅝
18	59	59¾	67	292	286¼	32 11/16	32¼	34 3/16	34⅝

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Aug.	Sterling Exchange "Checks"	Silver		Gold London	Aug.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
12	4.85 9/16	62½	28¾	84s11½d	16	4.85⅜	61⅞	28⅝	84s11½d
13	4 85¼	62	28⅝	84s11¼d	17	4.85⅜	61¾	28 9/16	84s 9¾d
14	4 85⅜	62	28 11/16	. . .	18	4 85 7/16	62	28⅝	84s 9¾d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Lead Shows Little Change

The volume of new business in the lead markets has been of only modest proportions, the West showing more life than the East. Deliveries under contract, however, continue large. The extremely active business of July and the first week of August has naturally been followed by a period of quietness. All of the producers are well sold for August, and as much lead no doubt remains to be bought for September, the market appears to be well balanced. The American Smelting & Refining Co. has maintained its contract price at 8.90c. New York. At the same time some small shipments for early delivery have been sold at 9c. Reports that brokers had offered 100 tons for August at 8.75c. New York are not given much credence. The leading interest in St. Louis has maintained its price at 8.75c., although some fractional lots brought premiums, at least one sale being made at 8.95c. On Monday, several carloads were sold at 8.70 and 8.72½c. The preponderant tonnage, however, all week has changed hands at 8.75c. and 8.90c. in St. Louis and New York respectively. Foreign ore lead is coming to the United States in preference to Europe, but bullion from Mexico all finds its way to the other side. London has been steady during the week.

Zinc Up to 7.40c.

Buying of zinc on the part of galvanizers has been in fairly good volume in the week ending today, practically all sellers having their share of the business as contrasted with many recent weeks, when one or two companies took the bulk of the orders. Prices have advanced gradually to 7.40c.,

yesterday and today, with most of the requests for September delivery. High-grade has been quiet at 8¾@9c., delivered in the East.

Tin Moves on Break

A sharp break in the London market on Thursday, Aug. 12, was reflected in a reaction in the domestic market, and consumers bought fair quantities on Thursday and Friday. Prices stiffened on Monday, and although the change was slight it discouraged buyers, and business has been dull with prices largely nominal. September tin is from ½ to ¾c. under the current price for prompt shipment. It is believed that consumers are pretty well supplied for their early needs and that buying will be confined to periods of recession.

Francs Slightly Higher

Closing cable quotations on Tuesday, Aug. 17, were as follows: francs, 2 835c.; lire. 3.30c.; and marks, 23.81c. Canadian dollars, ⅝ per cent premium.

Silver Closes Steady

Reports from London indicated sales of silver for China account on several days during last week, while, on the contrary, buying orders from that quarter have persisted in the local market both for New York and San Francisco delivery. However, with no support from India the selling predominated and prices declined on Aug. 17 to 28 3/16d. in London and 61⅜c. in New York. At the lower level the bazaars again entered the market as buyers, with a resultant advance in prices, and the tone appears steady at the close.

Mexican Dollars (old Mexican pesos): Aug. 12th, 47⅝c.; 13th and 14th, 47¼c.; 16th, 47⅛c.; 17th, 47c.; 18th, 47⅛c.

Other Metals

Quotations cover large wholesale lots unless otherwise specified. London prices are according to latest mail advices.

Aluminum—99 per cent grade, 27@28c. per lb.; 98@99 per cent, 27c. London, 98 per cent, £118 per long ton.

Antimony—Per lb., duty paid, New York: Chinese brands, spot 16¼c. September, 15½@16c. Some selling today following a dull week with nominal prices. Cookson's "C" grade, spot, 18@18½c. Needle and white oxide unchanged from issue of Aug. 7.

Bismuth—Per lb., New York, in ton lots, $2.70@$2.75. London, 10s.

Cadmium—Per lb., New York, 60c. London, 1s. 10½d. for American metal; 1s. 9d. for Australian metal.

Iridium—Per oz., $125@$135 for 98@99 per cent. Fair business at this level. London, £63@£65 in iridio-platinum.

Nickel—Per lb., ingot, 35c.; shot, 36c.; electrolytic, 39c. (99.75 per cent grade). London, £170@£175 per long ton according to quantity.

Palladium—Per oz., $69@$71. Pure metal as a constituent of crude platinum, $60@$65 per oz. London, £12@£15, nominal.

Platinum—Official price on refined metal continues at $116 per oz. Open market cash sales of large lots at $112. Pure metal as a constituent of crude platinum, $109.

London, £23½ per oz. for refined and £21@£22 for crude.

Quicksilver—Per 75-lb. flask, $88.50@$90. The market has improved during the week with increased inquiry from important consumers. Forward position commands a premium over spot.

San Francisco wires $89.33; steady. London, £15⅝.

The prices of **Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Tungsten,** and **Zirconium** are unchanged from the issue of Aug. 7.

Metallic Ores

Chrome, Iron, Manganese, Molybdenum, Tantalum, Tungsten, Uranium, and Vanadium Ores are unchanged from quotations in the Aug. 7 issue.

Zinc Blende Lower—Lead Ore Unchanged

Joplin, Aug. 14, 1926

Zinc Blende

	Ton
High (last week)	$54.15
High (this week)	54.20
Premium blende, basis 60 per cent zinc	$50.00@ 51.00
Prime Western, basis 60 per cent zinc	49.00
Fines and slimes, 60 per cent zinc	48.00@ 46.00
Average settling price, all zinc	48.39

Galena

High	$114.50
Basis 80 per cent lead	112.50
Average settling price, all lead	111.64

Shipments for the week: Blende, 18,226; lead, 2,930 tons. Value, all ores the week, $1,209,080.

That buyers were in need of less concentrate was evinced by lowering the price $1 per ton on all grades, and as a consequence only 10.340 tons was purchased, several sellers declining to accept the lower offering.

The following tabulation offers a sidelight on zinc blende market conditions:

Zinc Blende

	Total Production	Weekly Average	Total Shipment	Weekly Average
Seven months, 1926	496,210	16,007	485,890	15,680
Seven months, 1925	447,620	14,440	454,300	14,655
Increase	48,590	1,567	31,590	1,025
	31,590	1,025		
	17,000	542		

It is evident the demand was increased 31.590 tons, but it is shown that there is an excess production of 17,000 tons more than the demand, an average of 542 tons per week. Yet some producers wonder why zinc is lower than at this time last year.

Platteville, Wis., Aug. 14, 1926

Zinc Blende

Blende, basis 60 per cent zinc.... $52.75

Lead Ore

Lead, basis 80 per cent lead 112.50

Shipments for the week: Blende, 1,085 tons; lead, 54 tons. Shipments for the year: Blende, 33,666; lead, 846 tons. Shipments for the week to separating plants, 2,483 tons blende.

Non-Metallic Minerals

Magnesite—Imported ore, $40 per net ton, f.o.b. Eastern seaboard.

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Ilmenite, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystals, Silica, Spodumene, Sulphur, Talc, Tripoli, and **Zircon** are unchanged from prices in the Aug. 7 issue.

Mineral Products

Arsenious Oxide (White arsenic)—3½c. per lb. Good buying by arsenate manufacturers. Reports from cotton belt indicate increased requirements to combat the weevil. London, £13 per long ton.

Calcium Molybdate, Copper Sulphate, Sodium Nitrate, Sodium Sulphate (Salt Cake), and **Zinc Oxide** are unchanged from prices in the Aug. 7 issue.

Ferro-Alloys

Ferrotungsten—Per lb. contained W, f.o.b. works according to grade, $1@$1.05.

Ferrocerium, Ferrochrome, Ferromanaganese, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferro-uranium Ferrovanadium, and **Spiegeleisen** are unchanged from prices in the Aug. 7 issue.

Metal Products

Rolled Copper—Per lb., sheets, 23c.; wire, base price, 16¼c.

Lead Sheets, Nickel Silver, Yellow Metal, and **Zinc Sheets,** are unchanged from the prices quoted in the Aug. 7 issue.

Refractories

Chrome Brick, Firebrick, Magnesite Brick, Silica Brick, and **Zirkite** are unchanged from prices in the Aug. 7 issue.

Steel Strong—Pig Iron and Coke Quiet

Pittsburgh, Aug. 17, 1926

Finished steel prices hold perfectly, being in all respects as high as on July 1, while the sheet market is visibly stronger. Galvanized sheets are fairly firm at 4.30c., against a range of 4.20c. to 4.30c. hitherto.

Pig Iron—The Valley market remains quiet, but with somewhat better tone in that several sellers will not meet the minimum prices going. Bessemer, $18.50@$19.00; basic, $17.50; foundry, $17.50@$18.50, Valley.

Connellsville Coke—The turnover in spot remains light and the tone is said to be better. Spot furnace remains at $2.85@$3 and spot foundry at $4@$4.50. Several tentative inquiries have appeared for furnace coke on contract and producers are quoting prices higher than those made for the current quarter.

Company Reports

New Jersey Zinc Net for Six Months $3,291,434

The following table sets forth the financial results of the operations of the New Jersey Zinc Co. Besides mining and smelting ores the company produces a variety of manufactured products.

Statement for the Quarter Ended June 30, 1926

Income (including dividends from subsidiary companies) after deductions for expenses, taxes, maintenance, repairs, depreciation, depletion, and contingencies	$1,647,538.09
Deduct	
Interest on first mortgage bonds	40,000.00
Net income	$1,607,538.09
Deduct	
Dividend 2 per cent payable Aug. 10, 1926	981,632.00
Surplus for the quarter	$625,906.09

Summary for First Half Year of 1926

Net income		
For the first quarter		$1,683,896.01
For the second quarter		1,607,538.09
Net income for the half year		$3,291,434.10
Deduct		
Dividends declared		
Paid May 10,1926, 2 per cent	$981,632.00	
Paid July 10, 1926, 2 per cent	981,632.00	
Paid Aug. 10, 1926, 2 per cent	981,632.00	
		$2,944,896.00
Surplus for the half year ending June 30, 1926		$346,538.10

Gold Imports for Seven Months Exceed Exports by $82,000,000

During the first seven months of 1926 the United States imported $127,139,731 in gold. Exports totaled $45,489,600, leaving a surplus of $80,000,000 compared with a "deficit" of $134,366,618 for the year 1925.

During the first twenty-seven days of July, the gold movement at the port of New York was small. Imports, which came almost entirely from Latin America, totaled slightly more than $500,000. Exports amounted to $1,300,000, most of which went to Guatemala, the Straits Settlements, and Mexico. Movements other than through New York included overland shipments of $3,000,000 from Mexico and exports of $2,500,000 to Canada in the latter part of the month.

June figures show an import balance of more than $15,500,000, imports during that month totaling $18,900,000, including $8,700,000 from Mexico, $4,900,000 from Australia, and $3,400,000 from Chile. Exports reached $3,300,000, of which $1,000,000 was shipped to Colombia and about $500,000 each to Mexico and Salvador.

With the resumption of shipments of gold to Germany, an initial consignment of $2,500,000 having gone forward last week, the current year's import balance probably will be considerably reduced if Germany decides to take any large amount of her earmarked holdings here. Her total gold reserve abroad at present is estimated at $60,000,000.

The accompanying table indicates gold exports and imports monthly for the first seven months of the present year and for the entire year 1925, with respective totals:

	1926		1925	
	Imports	Exports	Imports	Exports
January	$19,351,202	$3,086,870	$5,037,800	$73,525,943
February	25,415,655	3,851,374	3,602,527	50,599,708
March	43,412,576	4,224,564	7,337,322	25,104,416
April	13,125,633	17,883,865	8,869,883	21,603,945
May	2,934,665	9,342,927	11,392,837	13,389,967
June	18,900,000	3,300,000	4,426,135	6,712,480
July	(a) 4,000,000	(a) 3,800,000	10,204,112	4,416,452
August	.....	.....	4,861,736	2,135,690
September	.....	.....	4,128,052	6,784,201
October	.....	.....	50,740,649	28,039,190
November	.....	.....	10,456,115	24,360,071
December	.....	.....	7,216,004	5,967,727
Totals	$127,139,731	$45,489,600	$128,273,172	$262,639,790

a Estimated.

Steadiness Marks Utah Copper Operations and Earnings

The Utah Copper Co. reports for the second quarter of 1926 a total net production of copper from all sources, in comparison with the output for the first quarter of 1926, as follows:

	Net Copper Produced, Lb.	Average Monthly, Lb.
1926—Second quarter	53,780,647	17,926,882
1926—First quarter	53,472,436	17,824,145

During the quarter the Arthur plant treated 1,466,300 dry tons of ore and the Magna plant 1,875,700 dry tons, a total for both plants of 3,342,000.

The average grade of ore treated at the mills was 0.99 per cent copper, and the average mill recovery of copper in the form of concentrates was 87.92 per cent of that contained in the ore, as compared with 1.01 per cent copper and 88.72 per cent recovery, respectively, for the previous quarter.

The average cost per pound of net copper produced, including depreciation of plant and equipment and all fixed and general expenses, and after crediting gold, silver, and miscellaneous earnings, was 8.5c., as compared with 8.9c. for the preceding quarter computed on the same basis.

The following tabulation shows the financial results of the company's operations for the quarter, as compared with the previous quarter.

	Second Quarter 1926	First Quarter 1926
Net profit from copper production	$2,516,372.97	$2,519,419.48
Miscellaneous income, including gold and silver	593,277.49	589,014.34
Bingham & Garfield Railway Co., dividend	75,000.00	75,000.00
Nevada Consolidated Copper Co., dividend	250,125.00	250,125.00
Income, miscellaneous securities	161,862.75	.....
Total income	$3,596,638.21	$3,433,588.82
Depreciation	299,801.85	303,701.16
To surplus	$3,296,836.36	$3,129,857.66

The total capping removed during the quarter was 2,465,574 cu.yd. as compared with 1,924,875 cu.yd. for the previous quarter.

Granby M. S. & P. Profit Higher

The Granby Consolidated Mining, Smelting & Power Co. reports for the quarter ended June 30, 1926, a profit of $461,833 after expenses and interest, but before depreciation and depletion. This compares with a profit of $429,598 in the preceding quarter and $269,861 in the second quarter of 1925. Profit for the first half of 1926 totaled $891,431 before depreciation and depletion, against $465,821 in the first half of the previous year. Income account for the six months ended June 30, for 1926 and 1925, is as follows:

	1926	1925
Gross	$2,623,456	$2,697,918
Expenses	1,676,253	2,041,923
Operating income	$947,203	$655,995
Other income	83,723	71,959
Total income	$1,030,926	$727,954
Interest	139,495	262,133
(a) Profit	$891,431	$465,821

(a) Before depreciation and depletion.

The company produced 9,519,032 lb. of copper, an average of 3,173,011 a month, in the second quarter, against 9,390,890, an average of 3,130,296 lb. a month, in the first quarter or a total of 18,909,922 lb. of refined copper in the first half year. After deducting the usual credit for precious metal values and miscellaneous earnings, but exclusive of income from outside investments, the cost of producing marketable refined copper is stated to have been 8.495c. a pound, compared with an average cost of 9.24c. a pound for the first quarter.

Allenby production for the second quarter came to 4,374,177 lb. of copper recovered from milling 153,949 tons of copper ore. During the preceding quarter 3,822,957 lb. of copper was produced from the treatment of 144,514 tons of ore. Profits from Allenby operations during the second quarter amounted to $86,733, compared with $55,749 in the first quarter. These production figures and profits are not included in Granby statistics for the quarter.

International Nickel Earnings Increase

Earnings of the International Nickel Co., mining and smelting nickel ores in the Sudbury district in Ontario, increased during the first half of 1926 as shown below:

Comparative Consolidated General Profit-and-Loss Statement

	Second Quarter June 30, 1926	Six Months June 30, 1926	Six Months June 30, 1925
Earnings	$2,149,301.92	$4,267,576.76	$3,774,049.27
Other income	36,647.89	85,888.06	114,688.10
Total income	$2,185,949.81	$4,353,464.82	$3,888,737.37
Administration and general expense	138,404.99	279,039.17	226,125.04
Reserved for federal and franchise taxes	229,588.91	477,262.84	368,023.43
Net operating income	$1,817,955.91	$3,597,162.81	$3,294,588.90
Depreciation and depletion	383,192.10	769,191.21	639,779.84
Foreign companies	.....	.....	8,500.00
Orford works property expense (a)	26,247.27	53,281.63	62,108.08
Profits	$1,408,116.54	$2,774,689.97	$2,584,200.98
Dividends, preferred	133,689.00	267,378.00	267,378.00
Common	836,692.00	1,673,384.00	.....
Balance	$437,735.54	$833,927.97	$2,316,822.98

(a) Insurance, taxes and pensions for ex-employees.

Bank Sees No Prospect of Transfer of Capital from Europe to America

Discussing the foreign debt situation, the National City Bank says:

"Whether the debts are cancelled or kept alive will in the long run make very much less difference to either debtors or creditors than they are thinking. It is agreed by all who have any competency for the discussion of the subject that the debts can be paid only in commodities or services, and none of the creditor countries are showing much inclination to accept payment by such means. Italy has paid $5,000,000 to the United States in the last year and borrowed more than $100,000,000 in the same time. It will be a long time before Europe will be impoverished at that rate, and there is no prospect that the flow between the United States and Europe will be reversed. The exports of the United States exceeded the imports again in our fiscal year just ended, and although the trade balance was reduced, the most significant thing about the details was that our exports of manufactures increased. The creditors of Germany on reparations account are discovering that the only way they can hope to make the full collections under the Dawes plan is by systematically organizing the importation of goods from Germany, but no such movement as that has developed in the United States, or is likely to.

"There is not the slightest probability that the debts due the United States are going to cause a drain of capital from Europe. Great Britain is making payments, but not by transferring capital from Great Britain. She is paying with earnings which otherwise would increase her investments in other parts of the world. This capital serves to increase our surplus for investment abroad, and whether the titles to such newly invested wealth are held in this country or Great Britain, the benefits will be distributed throughout the world. In short, economic conditions determine the distribution and use of capital, without much regard to where it may be owned, and the free play of economic forces may be expected to maintain the financial equilibrium of the world."

Consumption of Copper by Industries

Figures issued recently by the American Bureau of Metal Statistics show that consumption of copper in the United States during the second quarter of the current year was almost exactly the same as during the first quarter, though electrical manufacturing and automobile companies increased their takings. In fact, the automobile industry has increased its consumption in each of the last four quarters, setting a new record with the period ended June 30, over 2,000 tons greater than for the corresponding quarter last year. The building industry is showing a trend downward in its use of copper.

The industries enumerated in the following table represented 50.56 per cent of the total domestic consumption in 1925. The figures are in tons of 2,000 lb., and must be understood to be shipments from refineries rather than actual consumption. It is reasonable to consider, however, that no great difference existed in the tonnage of consumers' stocks at the beginning and end of the various quarters.

	1925 (Revised) I.	II.	III.	IV.	1926 I.	II.
Electrical manufactures	45,000	42,500	43,000	53,000	46,500	47,500
Automobiles	23,900	30,900	25,500	27,000	29,600	32,200
Buildings	9,250	9,550	13,500	14,400	13,300	11,300
Ships, commercial	500	550	700	350	500	550
Locomotives	450	500	400	450	700	650
Railway cars	1,800	1,700	1,000	700	1,300	1,800
Railway bearings	3,900	4,100	4,400	4,500	4,100	4,500
Manufactures for export	13,450	15,850	14,550	12,450	11,000	11,000
Total of above	98,250	104,750	103,050	112,850	107,000	109,500
Domestic deliveries from primary refiners	191,771	194,177	214,618	230,605	226,808	226,433

The trend of business with the largest electrical manufacturing companies is shown by the following statement of their bookings and billings.

	General Electric Bookings	General Electric Billings	Westinghouse Electric Bookings	Westinghouse Electric Billings
1924	$283,107,697	$299,251,869	$151,249,000	$163,601,000
1925				
First half	$150,315,228	.....	$84,538,211	$78,818,378
Second half	152,198,152	.....	83,057,096	83,985,155
Year	$302,513,380	$290,290,166	$167 595,307	$162,803,533
1926				
First quarter	$86,433,658	.....	$52,596,434	$44,861,438
Second quarter	78,972,000	.....	44,862,357	45,139,956
First half	$165,405,658	$147,450,867	$97,458,791	$90,001,394

Sharpe Sees Improvement in Zinc

A. J. M. SHARPE, honorary foreign correspondent of the American Zinc Institute, believes that the zinc market is improving—slowly but none the less surely—and that it will be surprising if there is not more activity before long. In his review as of Aug. 1, he says:

"The sheet zinc trade on the Continent continues to flourish, and no roller is today able to execute delivery of fresh orders inside two months; some of the more prominent are asking three months.

"The zinc oxide trade is also experiencing better times, and the net result is that there is a lesser quantity of slab zinc available for galvanizers and other purposes. Therefore, the outlook for livelier markets is most encouraging once the British coal crisis has been settled and the miners are back to work. The moment that occurs British galvanizers must enter the market for larger supplies of metal, as they, in common with other consumers in the United Kingdom, have allowed their stocks to be depleted to negligible proportions. Despite the coal strike, the English galvanizers are beginning to pick up some of their lost trade with the aid of imported steel and fuel.

"The brass trade in Europe is a little better occupied, but is, of course, not nearly as prosperous as in the United States. I do not know what percentage of high-grade zinc enters into the manufacture of brass in America, but so far as the Old World is concerned it is computed that this proportion has now reached 40 per cent. High-grade, 99.9 per cent, is now freely on offer at not more than $2 per ton over the price of ordinary metal, and as this premium declines so will the quantity absorbed by the brass founders tend to increase.

"The effect on statistics of the curtailment of output in the United States has afforded considerable satisfaction on this side, and the reduction of stocks on both sides of the Atlantic is regarded as one of the fundamentals for expecting higher zinc prices in the last quarter of the year."

Mr. Sharpe estimates world stocks of zinc on Aug. 1 as follows:

	Metric Tons
United States	20,900
Canada	2,300
Australia (including unsold shipments afloat)	2,200
Germany and Poland	5,800
Belgium	1,800
France	1,000
Great Britain	1,000
Scandinavia	200
Far East	500
Elsewhere	1,500
Total	37,200

Mining Stocks—Week Ended August 14, 1926

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	...	...	51	Jy.17, Au.23 Q	0.75
Arcadian Consol.	Boston	1⅛	1	1		
Ariz. Com'l	Boston	12¾	12⅛	12⅛	Jy. 16, Jy. 30	0.50
Calaveras	N. Y. Curb	1⅛	1⅛	1⅛		
Calumet & Arizona	New York	73⅛	70½	72⅛	Jn. 4, Jn. 21 Q	1.50
Calumet & Hecla	Boston	18⅛	17½	17⅝	Jn. 1, Jn. 15 Q	0.50
Cerro de Pasco	New York	73½	70	71⅞	Jy. 15, Au. 2, Q	1.00
Chile Copper	New York	34⅞	34⅛	34⅛	Sept. 1, Sept. 27, Q	0.62½
Chino	New York	...	...	22	Sept., 1920	0.37½
Con. Coppermines	N. Y. Curb	3½	3⅜	3⅜		
Copper Range	Boston	19	17½	18	May, 1925	1.00
Crystal Copper	Boston Curb	*40	*36	*37		
East Butte	Boston	4	3⅜	3⅜	Dec., 1919	0.50
First National	Boston Curb	*23	*16	*16	Feb., 1919	0.15
Franklin	Boston	*40	*40	*40		
Granby Consol	New York	25⅜	24⅜	24⅜	May, 1919	1.25
Greene-Cananea	New York	21¼	20	20	Nov., 1920	0.50
Hancock	Boston	1	1	1		
Howe Sound	New York	38⅞	36⅞	37½	Ap.1, Ap.15	0.75
Inspiration Consl	New York	25⅞	25	25	Jn.7, Jy.6, Q	0.50
Iron Cap	Boston Curb	3⅞	3½	3⅞	Jn. 1, Jn. 15	0.50
Isle Royale	Boston	14	13¼	13½	Jn. 1, Jn. 15	0.50
Jerome Verde Dev	N. Y. Curb	*79	*79	*79		
Kennecott	New York	58⅜	56½	57½	Sept. 3, Oct. 1 Q	1.00
Lake Copper	Boston	...	...	1½	June, 1925	0.50
Magma Copper	New York	42⅜	39½	39⅝	Jn.30, July. 15, Q	0.75
Mason Valley	N. Y. Curb	2⅜	2¼	2⅜		
Mass Consolidated	Boston	*50	*30	*45	Nov., 1917	1.00
Miami Copper	New York	15⅞	14⅜	14⅜	Aug. 2, Aug. 16 Q	0.25
Mohawk	Boston	43	40	41	Jy.31, Se.1 Q	1.00
Mother Lode Coa	New York	6½	6	6	Jn. 15, Jn. 30	0.37½
Nevada Consol	New York	14⅜	14	14⅛	Jn. 15, Jn. 30 Q	0.25
New Cornelia	Boston	24	23½	24	Au.6, Au.23 Q	0.04
North Butte	Boston	3	2⅞	2⅞	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	*60	*59	*60	Se. 1, Se. 15	0.05
Old Dominion	Boston	18	18	18	Dec., 1918	1.00
Phelps Dodge	Open Mar.	†128	†125	...	Jun.22, July2 Q	1.50
Quincy	Boston	23½	22	23	Mar., 1920	1.00
Ray Consolidated	New York	15⅜	14⅛	14⅜	Ap.20, Ap.30	0.25
Ray Hercules	N. Y. Curb	...	...	11⅜		
St. Mary's Min. Ld	Boston	*33½	*32	*32	Ap.17, My.18	2.00
Seneca Copper	New York	6⅛	5½	5½		
Shannon	Boston	...	...	*50	Nov., 1917	0.25
Superior & Boston	Boston	*75	*50	*75		
Tenn. C. & C.	New York	12⅛	11⅞	11⅞	Au.31, Se.15, Q	0.25
United Verde Ex	N. Y. Curb	28⅛	28	28⅛	Jy.17, Aug. 2,	0.75
Utah Copper	New York	...	...	104	Jn.15, Jn.31 Q	1.25
Utah Metal & T	Boston	1 1/16	1⅛	1⅛	Dec., 1917	0.30
Victoria	Boston	*55	*55	*55		
Walker Mining	Salt Lake	*81	*62	*67		
NICKEL-COPPER						
Internat. Nickel	New York	37⅛	36⅛	36⅞	Je.17, Je.30,	0.50
Internat. Nickel, pfd.	New York	....	...	104	Jy.12, Au.2,	1.50
LEAD						
Gladstone M. M. Co.	Spokane	*30	*28	*30	Jn. 10, Jy.10	0.01
National Lead	New York	165½	158	162½	Jn. 11, Jn. 30 Q	2.00
National Lead pfd	New York	117¼	116⅛	117¼	My.21, Je.15 Q	1.75
St. Joseph Lead	New York	44½	43	44⅜	Jn.10, Jn.21 Q	X0.75
ZINC						
Am. Z. L. & S.	New York	...	...	7⅛	May., 1920	1.00
Am. Z. L. & S, pfd.	New York	34⅛	31⅜	33	Nov., 1920	1.50
Butte C. & Z.	New York	5⅛	5	5⅛	De.10, De.24	0.50
Butte & Superior	New York	11⅛	10⅛	10½	Jn.15, Jn.30 Q	0.50
Callahan Zn-Ld	New York	2	1⅞	1⅞	Dec., 1920	0.50
Eagle Picher	Cincinnati	31⅞	31⅛	31⅛	Sept.10, Sept.30 Q	2.00
Eagle Picher, pfd.	Cincinnati	....	....	110	Aug.20, Sept.15 Q	1.75
New Jersey Zn	N. Y. Curb	....	....	208	July20, Aug.10 Q	2.00
United Zinc	N. Y. Curb	....	....	*70		
Yellow Pine	Los Angeles	*20	*20	*20	De.8, De.18 Q	0.04
GOLD						
Alaska Juneau	New York	....	....	1⅛		
Argonaut	Toronto	*22	*19¾	*21		
Barry-Hollinger	Toronto	*57	*51	*57		
Carson Hill	Boston	...	...	*22		
Consol. W. Dome L.	Toronto	*15⅞	*15	*15⅛		
Cresson Consol. G	N. Y. Curb	2⅜	2 3/32	2 5/32	Mh.31, Ap.10	0.10
Crown Reserve	Toronto	*10	*9	*9	Jan., 1917	0.05
Dome Mines	New York	11⅞	11⅛	11⅛	Jn.30, July 20, Q	0.50
Golden Center	N. Y. Curb	2⅜	2⅛	2⅜		
Golden Cycle	Colo. Springs	...	...	1.52	No.30, Dec.10 Q	0.03
Hollinger Consol	Toronto	19.50	19.30	19.40	Jy.27, Au.12 M	0.10
Homestake Mining	New York	55½	55⅛	55½	Au.20, Au.25 M	0.50
Kirkland Lake	Toronto	1.15	*98⅛	1.07		
Lake Shore	Toronto	13.45	12.25	13.40	Jn.1, Jn. 15 Q	0.10
McIntyre-Porcupine	New York	...	....	25⅛	Au.2, Se.1 Q	0.25
Newray	Toronto	1	1	1		
Noranda	N. Y. Curb	17⅞	17⅛	17⅝		
Night Hawk Pen	Toronto	*8	*8	*8		
Portland	Colo. Springs	....	....	*43½	July6, July15	0.02
Premier Paymaster	Toronto	....	....	2.16		
Rand Mines	New York	....	....	35	Au.23-30 Am.Sh.	1.52
Teck-Hughes	Toronto	4.11	3.84	4.08	Jy. 15, Au. 2	0.05
Tom Reed	Los Angeles	*50	*50	*50	Ma.10 Ma.20	0.02
Tough-Oakes	Toronto	*44½	*39½	*42		
United Eastern	N. Y. Curb	...	...	*50	July, 1924	0.05
Vipond Cons	Toronto	1.80	1.77	1.80		
Wright-Hargreaves	Toronto	8.45	8.10	8.40	Jn.15, Jy.1 Q	X 0.07½
Yukon-Alaska Trust	N. Y. Curb	....	....	21		
GOLD AND SILVER						
Carnegie Metals	Boston	13	13	13		
Con. Cortez	N. Y. Curb	*5	*5	*5		
Con. Virginia	San Francisco	*10½	*9½	*10½		
Continental Mines	N. Y. Curb	....	....	*45		
Dolores Esperanza	N. Y. Curb	....	....	*40	July, 1923	0.05
Premier Gold	N. Y. Curb	....	....	2⅛	Jn.18, Jy.3 Q	0.08
Tonopah Belmont	N. Y. Curb	2⅜	2 3/16	2⅜	Se.15, Oc.1	0.05
Tonopah Extension	N. Y. Curb	....	....	*50	Apr. 1925	0.05
Tonopah Mining	N. Y. Curb	6	6	6	Ap.7, Ap.21 Q	0.07½
Unity Gold	N. Y. Curb	...	...	*30		
West End Consol	N. Y. Curb	...	...	*17	Mar., 1923	0.05
Yukon Gold	N. Y. Curb	*20	*20	*20	June, 1918	0.02

Stock	Exch.	High	Low	Last		Last Div.
SILVER						
Alvarado	N. Y. Curb	....	....	1	Oct., 1920	0.50
Beaver Consol	Toronto	*83	*75½	*80	May. 1920	0.03
Castle-Trethewey	Toronto	1.54	1.44	1.49		
Coniagas	Toronto	4.50	4.00	4.40	May, 1924	0.12½
Keeley	Toronto	1.85	1.65	1.79	Ma. 1, Ma. 15 X	0.12
Kerr Lake	N. Y. Curb	1	1	1	Ap. 1, Ap. 15	0.12½
La Rose	Toronto	*40½	*40	*40½	Apr., 1922	0.10½
Lorrain Trout Lake	Toronto	*50	*50	*50	Jy. 2, Jy. 15	0.05
McKinley-Dar.-Sav	Toronto	*14	*14	*14	Oct., 1920	0.03
Mining Corp. Can	Toronto	3.97	3.89	3.92	Jy.1, Jy.15	0.12½
Nipissing	N. Y. Curb	5¼	5⅛	5⅛	Jn.30, Jy.20	0.15
Temiskaming	Toronto	...	...	*50	Jan., 1920	0.40
SILVER-LEAD						
Ahumada	New York	8⅛	8	8	Jn.18, Jy.5, Q	X 0.25
Alta Merger	Salt Lake	†*5¼	†*2			
Bingham Mines	Boston	37	35	36	Jn.19, Jn.30 Q	1.00
Cardiff M. & M.	Salt Lake	*40	*38	*40	De.16, No.18	0.10
Chief Consol.	Salt Lake	3.90	3.00	3.00	Jy.10, Au 10 Q	0.10
Cleveland-Cliffs Iron	Cleveland	*81½	*80	*85		
Emma Silver	Salt Lake	†1	†*50			
Erupcion	Boston Curb	1⅛	1 1/16	1 1/16	Jn.18, Jy.5, Q	X 0.10
Federal M. & S.	New York	...	...	81		
Federal M. & S., pfd.	New York	76½	75	75	My.25, Ju.15 Q	1.75
Hawthorne Mines	N. Y. Curb	*14	*13	*13		
Hecla Mining	N. Y. Curb	18	18	18	My.15, Je.15 Q	0.50
Iron King Mining	Salt Lake	...	...	*20		
Keystone Mining	Salt Lake	†*35	†*26	....	Au.12, Au.26	0.07½
Lucky Jim	Spokane	*15½	*15	*15½		
Lucky-Tiger Combination	Kansas	....	....	9.25	Au.10, Au.20	X 0.07
Mammoth Mining	Salt Lake	....	....	2.80	Mar.24, Apr. 1	0.10
Marsh Mines	Spokane	3.00	2.50	2.50	Se.15, Oc.1	0.15
Park Utah	New York	6.90	6.85	6.85	Jn.15, Jy.1 Q	0.15
Plutus Mining	Salt Lake	....	....	1.75	July 15	0.10
Prince Cons	Salt Lake	*75	*50	*50		
Silver King Coal	Salt Lake	8.80	8.80	8.80	Jn. 21, July 1, Q	0.25
Silversmith	Spokane	*47	*46	*46½	Jn.30, Jy.10 Q	0.02
Tamarack-Custer	Spokane			*29	Sept., 1924	0.25
Tintic Standard	Salt Lake	13.00	12.75	12.75	Jn.16, Jn.26,	0.40
Utah-Apex	Boston	8⅜	7⅞	8⅛	Jy. 3, Jy.15 Q	0.25
Western Utah Copper	N. Y. Curb	...	...	*8		
IRON						
Bethlehem Steel	New York	49½	46½	47⅞	July, 1924	1.25
Colorado Fuel & Iron	New York	47⅛	43⅜	45⅛	May, 1921	0.75
Gt. North'n Iron Ore	New York	20⅜	19⅜	20	De. 4, De. 28,	0.75
Inland Steel	New York	43½	42⅜	42⅜	Au.13, Se.1 Q	0.62½
Mesabi Iron	N. Y. Curb	1⅛	1⅛	1⅛		
Replogle Steel	New York	10⅛	9⅜	10⅛		
Republic I. & S.	New York	63⅜	59⅜	61⅛	Au.14 Se.1	1.00
Republic I. & S. pfd.	New York	98½	98	98½	Se.15, Oc.1 Q	1.75
Sloss-Sheffield S. & I.	New York	142½	132½	139	Jn.10, Jn.21 Q	1.50
Sloss-Shef. S.&I. pfd.	New York	...	...	107½	Jn 21, July.1, Q	1.75
U. S. Steel	New York	156⅜	147½	156⅜	Se.2, Se.29 Q	1.75
U. S. Steel pfd	New York	128⅞	128⅛	128⅜	Au 3, Au 30, Q	1.75
Virginia I. C. & C.	New York	43⅛	43⅛	43⅛	Jan., 1924	1.50
Virginia I.C.&C.pfd	New York	...	...	70	Jn.1, July 2,	2.50
ALUMINUM						
Alum. Co. of Amer	N.Y.Curb	73⅛	69⅛	73		
Alum. Co. of Amer pf.	N.Y.Curb	....	....	101½	June 15, July 1, Q	1.50
VANADIUM						
Vanadium Corp.	New York	41⅞	36½	41⅞	Au.2, Au.16, Q	0.75
ASBESTOS						
Asbestos Corp., New	Montreal	18	16½	17¾	De.31, Ja.15 Q	1.50
Asbestos Corp., pfd.	Montreal	71½	66	69	Jy.1, Jy.15, Q	1.75
SULPHUR						
Freeport Texas	New York	31⅛	29½	30½	Nov., 1919	1.00
Texas Gulf	New York	171½	163⅝	171½	Jn. 1, Jn. 15, Q	2.50
DIAMONDS						
De Beers Consol	New York	...	...	35½	Ju.16, Ju.17	1.70
PLATINUM						
So. Am. Gold & P	N. Y. Curb	4⅛	4⅛	4⅛		
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	53⅛	52⅛	53	Au.20, Se. 1, Q	1.00
Amer. Metal pfd	New York	116	116	116	Au.21, Se. 1 Q	1.75
Amer. Sm. & Ref.	New York	150	136⅝	147	Jy.10, Au 2, Q	1.75
Amer. Sm.&Ref.pfd.	New York	118⅛	117½	118⅛	Au.7, Se.1, Q	1.75
Consol. M. & S.	N. Y. Curb	....	....	2.20	Jn.30, Jy.5 QX	3.75
Federated Metals	N. Y. Curb	13	12⅞	13		
Newmont Mining	N. Y. Curb	67⅞	64⅝	67	Mar.31, Apr.15,	0.60
Southwest Metals	N. Y. Curb	....	....	1		
U. S. Sm. R. & M.	New York	39	37½	38⅜	Jy. 7, Jy. 15, Q	0.87½
U. S. Sm. R.&M.pfd.	New York	50	48½	48½	Jy. 7, Jy. 15, Q	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Henry Sachs, Colorado Springs, Colo.

PRICE WEEK ENDED AUG. 3, 1926

Name	High	Low	Last		Last Divd. Date	Amoun
Aramayo Mines (25 frs.)	81/3	81/—	81/3	May.	1926	5 p.c.†
British Platinum (£1)	5/6	5/—	5/—	Feb.	1925	2½ p.c.
Burma Corpn. (10 rupees)	16/4½	16/—	16/1½	Aug.	1926	7 annas*
Bwana M'Kubwa (5s)	7/6½	7/3	7/4½			
Camp Bird (2s)	4/1½	4/—	4/—			
El Oro (£1)	9/4½	8/9	9/—	Nov.	1924	2½ p.c.*
Esperanza (10s)	1/0½	10¼d	1/—			
Frontino & Bolivia (£1)	7/7½	6/3	6/3	July	1926	2½ p.c.
Mexican Corpn. (£1)	15/9	15/3	15/9	Dec.	1925	12½ p.c.*
Mexico Mines of El Oro (£1)	25/—	23/9	23/9	June	1926	7½ p.c.*
Oroville Dredging (£1)	4/—	3/9	3/9	Dec.	1923	3¾ p.c.
Ouro Preto (£1)	2/1½	2/1½	2/1½	May	1925	2½ p.c.
Rhodesian Congo Border (£1)	117/6	116/3	117/6			
St. John del Rey (£1)	8/9½	8/9	8/9	June	1925	6½ p.c.
San Francisco Mines (10s)	30/1¼	29/9	30/—	June	1926	15 p.c.
Santa Gertrudis (£1)	18/6	18/3	18/6	July	1926	5 p.c.
Selukwe (2s. 6d.)	13/6	13/—	13/3	April	1917	6¾ p.c.
S. Amer. Copper (2s.)	4/4½	4/1½	4/4½	Nov.	1917	75 p.c.
Tanganyika (£1)	41/3	39/8½	41/3	Sept.	1925	5 p.c.
Tomboy (£1)	4/1½	3/9	4/—	July	1926	10 p.c.
Union Miniere du Haut-Katanga (Brussels)	9.975	9.550	9.550	July	1926	175 frs.‡

* Free of British income tax. † Swiss frs. ‡ Belgian frs.